AKAMAI WORKFORCE INITIATIVE

Summer Internship Symposium
Project Abstracts

Pasadena August 9, 2019
TMT Project Office

Maui August 12, 2019
University of Hawaiʻi, Maui College

Hilo August 14, 2019
Hilo Hawaiian Hotel

Waimea August 16, 2019
W.M. Keck Observatory Headquarters

UNIVERSITY OF CALIFORNIA SANTA CRUZ

ISEE Institute for Scientist & Engineer Educators

Advancing Hawaiʻi college students into science and technology careers

2019 Akamai Internship Program

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, followed by 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, the students 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) originally funded by the National Science Foundation (NSF) Science and Technology Center. The goals of the Akamai program are to address the technical workforce needs in Hawaiʻi and advance students from diverse backgrounds into science, technology, engineering and mathematics (STEM) careers. Interns receive college credit from UH Hilo.

2019 Host Organizations

Hilo, Hawaiʻi Island

- Gemini Observatory
- Hawaiʻi Electric Light Company (HELCO)
- Pacific International Space Center for Exploration Systems (PISCES)
- Smithsonian Submillimeter Array (SMA) / Academia Sinica Institute of Astronomy and Astrophysics (ASIAA)
- Subaru Telescope
- UH Institute for Astronomy

Kawaihae & Kona, Hawaiʻi Island

- Cyanotech Corporation
- Liquid Robotics

Waimea, Hawaiʻi Island

- W.M. Keck Observatory
- Canada-France-Hawaii Telescope (CFHT)

Kahului, Maui

- HNu Photonics

Kihei, Maui

- Air Force Research Laboratory (AFRL)
- Akimeka LLC
- Maui High Performance Computing Center
- Pacific Defense Solutions, a Centauri company

Pukalani, Maui

- Daniel K. Inouye Solar Telescope (DKIST)
- UH Institute for Astronomy

Pasadena, CA

- Thirty Meter Telescope International Observatory (TIO)

Santa Cruz, CA

- TMT/UC Observatories (WFOS)

AKAMAI WORKFORCE INITIATIVE

ISEE Institute for Scientist & Engineer Educators

Akamai Workforce Initiative 2019

Staff

Institute for Scientist & Engineer Educators at University of California, Santa Cruz (ISEE/UCSC)

Lisa Hunter,	**Director**
Austin Barnes,	**Akamai Program Manager**
Nicole Mattacola,	**Program & Event Coordinator**
Jerome Shaw,	**Associate Director, Akamai R&D**
Rafael Palomino,	**ISEE Program Manager**
Nicholas McConnell,	**ISEE Program Manager**
Tamara Ball,	**R&D Manager**
Cynthia Carrion,	**ISEE Program Assistant**
Kauahi Perez,	**Akamai Communication Course Instructor**

2019 Akamai PREP Course Instructors

Austin Barnes, Lead Instructor	ISEE/UCSC
David Harrington, Co-lead Instructor	Daniel K. Inouye Solar Telescope
Jerome Shaw	ISEE/UCSC
Nicholas McConnell	ISEE/UCSC
Rafael Palomino	ISEE/UCSC
Zack Briesemeister	UCSC, Astronomy & Astrophysics
Devin Chu (Design Team Lead)	UCLA, Physics & Astronomy
Ryan Dorrill	U Hawaii, Physics & Astronomy
Ryan Dungee	U Hawaii, Institute for Astronomy
Maissa Salama (Design Team Lead)	U Hawaii, Institute for Astronomy
Stacey Sueoka	Daniel K. Inouye Solar Telescope

2019 Communication Instructors

Austin Barnes, Co-lead Instructor	ISEE/UCSC
Rafael Palomino, Co-lead Instructor	ISEE/UCSC
Lisa Hunter	ISEE/UCSC
Michael Nassir	Univ. of Hawai‘i at Manoa
Kauahi Perez	Univ. of Hawai‘i at Manoa
Jerome Shaw	ISEE/UCSC
Nicholas McConnell	ISEE/UCSC
Stacey Sueoka	Daniel K. Inouye Solar Telescope

Special Thanks . . .

There are many people and organizations that have contributed to making Akamai a success and played a role in the 2019 Internship Program. We apologize if we have left your name off; thank you all for your contributions!

2019 Akamai Selection Committee
Joey Andrews (Akimeka), Channing Chow, (IAI/PDS), Chriselle Galapon (DKIST), David Harrington (DKIST), Joseph Janni (Air Force), Mary Beth Laychak (CFHT), Pamela Madden (NELHA), Heather Marshall (DKIST), Luke McKay (IfA Hilo), Rob Nelson (Akimeka), Mike Nassir (UH Manoa), Lucio Ramos (Subaru), Devin Ridgley (HNu Photonics), Ranjani Srinivasan (ASIAA/SMA), Chris Stark (Gemini), Ryan Swindle (AFRL), Truman Wold (Keck)

2019 Akamai Mentor Council
David Harrington (DKIST), Peter Konohia (Akimeka), Mary Beth Laychak (CFHT), Heather Marshall (DKIST), Keith Olson (NELHA), Lucio Ramos (Subaru), Ranjani Srinivasan (SMA/ASIAA), Chris Stark (Gemini), Ryan Swindle (AFRL), Warren Skidmore (TMT), Marianne Takamiya (UH Hilo), Truman Wold (W.M. Keck)

Air Force Research Laboratory
Scott Hunt, John Schmidt and Scott Pierce. *Mahalo for mentoring and program advocacy!*

Akabotics LLC
Monica Parks and Newton Parks. *Mahalo for mentoring!*

Akimeka LLC
Doug Simons, Lisa Burleson, Peter Konohia, Rob Nelson, Desislava Iorgova, and Joey Andrews. *Mahalo for mentoring, hosting our Maui selection committee meeting, and especially to Lisa and Peter for giving rides to our interns!*

Canada-France-Hawaii Telescope
Mary Beth Laychak, Ivan Look, Grant Matsushige, Windell Jones, Simon Prunet, Greg Barrick and Tom Benedict. *Mahalo for mentoring and providing housing for our interns!*

Cyanotech Corporation
Court Warr and Charley O'Kelly, *Mahalo for mentoring!*

Daniel K. Inouye Solar Telescope (DKIST)
David Harrington, Stacey Sueoka, Chriselle Galapon, Brialyn Onodera, Mackenzie Stratton, Lance Leber, Christopher Gedrites, Shawn Haar, Stephen Guzzo, Keith Cummings, Heather Marshall, Thomas Rimmele, and Andre Fehlmann. *Mahalo for being a sponsoring partner, mentoring, and providing PREP instructors!*

Gemini Observatory
Chas Cavedoni, Angelic Ebbers, Jerry Brower, Stacey Kang, Matt Taylor. *Mahalo for mentoring and hosting our Hawaiʻi Island selection committee meeting!*

Hawaii Electric Light Company (HELCO)
Robert Kaneshiro, Lisa Dangelmaier. *Mahalo for mentoring!*

HNu-Photonics
Devin Ridgley, Brittany Willbrand, Sylvia Loh. *Mahalo for mentoring!*

Institute for Astronomy, Hilo & Maui
Luke McKay, Mark Chun, Paul Barnes, Christoph Baranec, Jeff Kuhn, Andre Fehlmann, Dave Harrington, Lucas Tarr, Xudon Sun. *Mahalo for mentoring!*

Liquid Robotics
Billy Middleton, Ryan Kopcso. *Mahalo for mentoring!*

Maui High Performance Computing Center
Robert Travino, Wesley Emeneker. *Mahalo for mentoring!*

Pacific Defense Solutions, a Centauri company
Channing Chow, Greg Martin, Oliver Grillmeyer. *Mahalo for mentoring!*

PISCES
Kyla Defore, Christian Anderson, Rodrigo Romo. *Mahalo for mentoring!*

Smithsonian Submillimeter Array SMA/ Academia Sinica Institute of Astronomy and Astrophysics ASIAA
Ranjani Srinivasan, Derek Kubo, Peter Oshiro. *Mahalo for mentoring!*

Subaru Telescope
Russell Kackley, Lucio Ramos, Shintaro Koshida, Philip Tait, Eric Jeschke. *Mahalo for mentoring!*

Thirty Meter Telescope International Observatory
Sandra Dawson, Gary Sanders, Warren Skidmore, Lianqi Wang, Gelys Trancho, Holly Novak, Magnolia Ycasas, Ben Irarrazaval, Jamie Nakawatase, Hugh Thompson, Peter Byrnes. *Mahalo for mentoring and being a sponsoring partner!*

TMT/UC Observatories (WFOS)
Renate Kupke, Kyle Westfall. *Mahalo for mentoring*!

W. M. Keck Observatory
Jeannette Mundon, Truman Wold, Matthew Brown, Jason Chin, Ed Wetherell, Shelly Pelfrey, Peter Wizinowich, Hilton Lewis, Leslie Kissner and Rich Matsuda. *Mahalo for mentoring, sponsoring an intern, hosting the symposium and more!*

Terric Abella
Columbia University

Site: HNu Photonics – Kahului, Maui
Mentors: Brittany Willbrand, Devin Ridgley

Script Development in Python for Process Improvement in Agricultural Imaging Analysis

HNu Photonics has engineered the AgroSonic, a frequency-emitting device used to enhance plant growth, and the Agrochip, a cell culture vessel that automates imaging and maintenance of plant cells. To quantify the efficacy of these devices, researchers use time-lapse imaging to capture plant growth at macro and cellular levels, then manually analyze thousands of images. Requirements were elicited from key stakeholders to outline user specifications and understand how automated image analysis could improve efficiency and reduce labor costs. I developed Python scripts to quantify ripening stages of climacteric fruit, correlate RGB values with chlorophyll and carotenoid production in mango leaves, and calculate percent defoliation of taro leaves. For analysis of plants at a cellular level, a cell counting script was developed to count and calculate the size of protoplasts in AgroChip. After script development, guides were created to assist with end-user training. The python scripts reduced labor inputs and improved imaging analysis processes, which will permit rapid deployment of these devices to field and laboratory settings.

Biography:
Tojo grew up in Makakilo on the island of Oahu. He graduated from Kamehameha Schools Kapalama in 2018 and is studying computer science at Columbia University in New York City. In high school, he was on the math team and conducted cancer research. He enjoys playing basketball, eating salted broccoli, playing video games, and staying rat lungworm-free. He hopes to one day pursue a career in STEM to make positive impacts on society while satisfying his passion for learning.

Christopher P. Artates
California State Polytechnic University, Pomona

Site: Gemini North Observatory – Hilo, Hawai'i Island HI
Mentor: Angelic W. Ebbers

Low-Level Motion and Control Systems Upgrade for Laser Guide Star Beam Steering

Gemini North Observatory upgraded their Laser Guide Star Facility (LGSF) to use a Toptica laser, replacing the decommissioned LMCT laser. An updated Beam Injection Module (BIM) was developed to position the laser along the same path as the previous one, controlling mirrors and polarizers to steer and attenuate the beam. In the commissioning phase of the new LGSF, flexure in the system necessitated the use of closed-loop motion control with encoder feedback to compensate for the flexure and variable travel distances as the telescope deviates from true zenith. The New Focus 8743-CL motor controller was selected for its support for closed-loop operation and its compatibility with EPICS control system software. However, the drivers available only provided open-loop control and basic motor commands, requiring manual configuration for operation. Additionally, due to power constraints, the controller can move only one motor at a time, limiting compound motion of two mirror axes to be sequential rather than simultaneous. For this project, I implemented driver-level support for closed-loop control and expanded the controller's basic motor functionality. The updated driver, written in C and C++, maintains backwards compatibility with the open-loop model, works with the linear and rotary actuators in the BIM, and accesses previously unreported motor statuses such as limit switch triggering and the presence of an encoder. To allow for compound motion, I proposed a workaround in the BIM schematics where two controllers already in use on the optical bench would control two mirror axes independently. After testing the 8743-CL's upgraded functionality and documenting the changes, the driver was commissioned for use with Gemini's Laser Interlock System that controls the BIM and contributed to the EPICS community as open source software for others to use, modify, and replicate for other controllers and applications.

Biography:
Christopher Artates was born in California and raised on Maui, graduating from H. P. Baldwin High School in 2016. At Baldwin, he dedicated much of his time to the FIRST Robotics program, but was also involved in the Japanese culture club, book club, and Science Olympiad, and volunteered with the Hawaii Animal Rescue Foundation. Christopher returned to California to study Computer Science at De Anza College in the Bay Area before transferring to California State Polytechnic University, Pomona, majoring in Electrical and Computer Engineering and minoring in Physics. He enjoys tinkering with hobby electronics and robotics and practicing his programming skills. Christopher serves as a STEM instructor for K-12 students around the Greater Los Angeles Area.

Nicole Baptist
Boston University

Site: Thirty Meter Telescope Project Office – Pasadena, CA
Mentors: Ben Irarrazaval, Jamie Nakawatase, Gelys Trancho

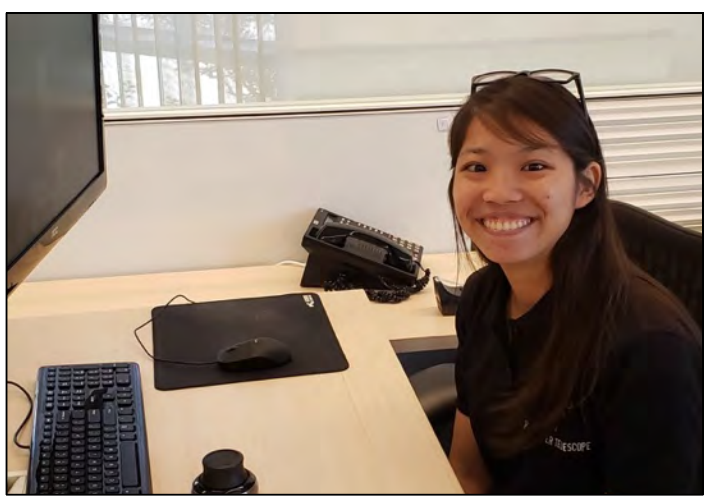
Thirty Meter Telescope Utility Room Management and Modeling

In order to maximize the imaging capabilities of the Thirty Meter Telescope's optical equipment, there requires a number of systems to maintain ideal conditions about its mirrors. From electrical and mechanical systems to computer systems, this mechanical giant requires the collaboration of compressed air, refrigerant, control, and power systems. All such systems are required to fit comfortably and safely within the utility room, a small section of building outside of the enclosure that amounts to a mere 20% of the entire structure. Another challenge posed to the process of arranging the parts in the utility room is that the project is still undergoing design revisions, making it difficult to determine, or sometimes even to select the most recently updated model of each component. This project focuses on the components added, removed, and modified, as recorded in relative documentation, and the ways in which they are best arranged in the allotted space for potential design layouts of the telescope's utility room. To begin, it is first necessary to compile a catalogue that will list all necessary information regarding each system's required components and regulations. The data used was extracted from a variety of TMT documents dating from 15 years ago until the present day, and compiled in an excel spreadsheet that listed each component's designated system, quantity, dimensions and mass, orientation required for access, required clearance space, reference document links, and any relevant notes. Additional parts without documented models were then selected from designated vendors with respect to its system's requirements listed in the spreadsheet. From here, the components were then modeled in 3D, and arranged within a virtual representation of the utility room using computer aided design, or CAD software. As the final layout will be chosen and likely modified after the completion of this project, several proposed arrangements are expected to allow for flexibility in the construction of the upcoming TMT utility room. These plans will both ensure the proper positioning of any components added in the future, and serve as a helpful guide when the systems are due for maintenance. In addition, peripheral details, such as the piping and wiring layouts, can be finalized for a complete interpretation of the project. From these methods, it is possible to map the locations of all working components, their necessary wiring and piping, and any additional organizational components to ensure both the working efficiency of each system, and within each system, each component's ease of accessibility.

Biography:

Nicole Baptist was born and raised on the island of O'ahu. After graduating from Punahou School, she enrolled in Boston University where she is now a rising senior majoring in mechanical engineering. Her main educational and career interests lie in technical design and robotics.

She is a member of Boston University's Hawaii Cultural Association and Racing Team, and is a learning assistant for introductory physics. In her spare time, Nicole enjoys animating, hanging out with friends and family, taking things apart, putting them back together, and, of course, boogie boarding.



David Bennett
Hawaiʻi Community College, Electronics Technology

Site: Institute for Astronomy – Hilo, Hawaiʻi Island HI
Mentors: Luke McKay, Mark Chun
Collaborator: Robert Calder

Upgrading the Control Electronics of the UHWFI Filter Wheel

The University of Hawaiʻi 2.2-meter Telescope (UH88) has long been a leader in the implementation of large-format imaging arrays. In line with that legacy, a new STA 10 K CCD camera was commissioned under a NASA grant to aid in the UH Near-Earth Object (NEO) Follow-Up program. The new camera will improve readout time and the field-of-view will be nearly four times that of the current detector. Because of the large 95 x 95 mm size of the STA CCD array, the smaller optical filters utilized by the current camera would vignette the incoming light to the detector. Therefore, large-format filters and an accompanying filter wheel will need to be incorporated into the telescope. We will achieve this by utilizing an existing filter wheel housing from the University of Hawaiʻi Wide-Field Imager (UHWFI) project. The filter wheel can accommodate up to six 165 mm square filters and is driven by a Geneva drive with a spring-loaded detent. Upgrading the control electronics of the UHWFI filter wheel housing in preparation for the STA camera installation is the primary focus of my project. Hall-effect sensors are used to verify the position of the filter wheel by sensing small magnets embedded in the wheel at each filter location. I replaced the original analog Hall-effect sensors with linear output Hall-effect sensor IC's (Integrated Circuits) to avoid needing a precision power supply and separate analog-to-digital converter (ADC). I designed an aluminum bracket to hold a new circuit board containing the sensors and associated electronics at a precise position along the filter wheel path. An Arduino-compatible Mechaduino stepper motor control board was attached to a stepper motor to rotate the filter wheel into position. I then wrote an Arduino program to both control the stepper motor as it turns the filter wheel and to read the Hall-effect sensors as they verify the position of the filter wheel. Integrating the STA camera with the upgraded UHWFI filter wheel controls will not only expedite object acquisition for the UH NEO Follow-Up program, but also aid in the planned transformation of the UH88 observatory from a classical/visitor observing mode to a queued service observing mode in order to maximize scientific productivity.

Biography:
David Bennett is from Salt Lake City and moved to Hilo with his wife in 2012. Dave attended Southern Utah University as a Mathematics major/Art minor and the University of Hawaii at Hilo as an Astronomy major where he had the opportunity to travel to Namibia to be the Resident Astronomer for the Sossusvlei Desert Lodge in 2016. He is currently pursuing an Associate in Applied Science degree through the Electronics Technology program at the Hawaiʻi Community College and is also preparing for the Cisco CCNA Certification exams. After graduation, Dave intends to pursue a career as a technician or an operator at one of the Mauna Kea Observatories. He has been an amateur astronomer since he was 15 and built his first telescope for the 1986 apparition of Halley's Comet. In his spare time, Dave enjoys camping, hiking, playing with his dog Hokuleʻa, reading science fiction, and editing videos for his wife Kea's dance performances at UH Hilo.

Jett Bolusan
California Polytechnic State University, San Luis Obispo

Site: Daniel K. Inouye Solar Telescope – Pukalani, Maui
Mentors: Mackenzie Stratton & Lancer Leber

Not So 'Good Vibrations'

The Daniel K. Inouye Solar Telescope [DKIST] is the world's largest solar telescope and is comprised of many moving parts including the telescope itself, the coude, and the enclosure (dome around the telescope). When operating the enclosure, there is a large clanging noise that occurs. The noise is not easily reproduced but occurs every time the enclosure is operated. A large clanging noise is often indicative of a large impact force or energy transfer, dissipation, and/or absorption. Energy transfer due to this unknown noise was not accounted for in the enclosure's design and may be causing unnecessary wear on the azimuth-rail system, reducing telescope lifetime. The objective of this project was to determine the general locations and magnitudes of forces felt by the bogies. We attached accelerometers in special configurations on two of the bogies that support the majority of the weight of the enclosure in order to determine the direction and magnitudes of forces felt by the bogies. Varying enclosure rotation speeds were then tested. The accelerometers provided data on displacement at various locations on the enclosure and allowed for peaks or areas of maximum deformation and direction to be observed. From the direction and magnitude of peaks, dominant directions of force (radial and normal[vertical]) as well as location on the azimuth-rail system were deduced, allowing for future specific tests to be conducted that will allow for the true cause of the noise to be determined. Future tests are recommended to focus on vertical displacement as well as radial displacement of both the bogie and enclosure itself to determine if deformation of the rails or movement of the enclosure are the cause of the noise.

Biography:
Jett is a Class of 2017 graduate of Maui Highschool. He is an upcoming third year at California Polytechnic State University, San Luis Obispo, majoring in Mechanical Engineering, general concentration, with an emphasis in energy collection and conversion. The release of a new concentration in Fall 2019 has him considering a concentration in energy resources. Jett is interested in everything relating to energy and is still exploring whether he wishes to enter industry to focus on energy storage or collection. As of now, Jett has his sights on entering the renewable resources industry in hopes of finding a sustainable and environmentally friendly way to harness energy from the ocean.

Jennifer Bragg
University of Hawaii at Hilo

Site: Institute for Astronomy in Hilo, Big Island HI
Mentor: Mark Chun

Development and Analysis of a Temperature Sensor Network to Determine Sources of Image Degradation at the University of Hawaii 2.2-Meter Telescope

The UH88 telescope is experiencing a problem with image degradation. In my project I analyzed sources of image degradation from within the telescope. I test the hypothesis that there is distortion happening due to the heat within the telescope and/or inside the facility. I did this by measuring and monitoring the temperatures of various locations with temperature sensors within the facility such as the primary mirror, dome air, and telescope structure. By recording a constant stream of data from temperature sensors located at the telescope, I was able to analyze the temperature of different locations under various conditions over different spans of time. I then developed a data logging system in Python to be able to collect, format and plot these data sets in a multitude of ways. After plotting different conditions and locations against each other and finding the hourly averages over a day, week, and month along with the standard deviations, I compared these plots to find certain correlations. I then estimated the temperature time constants, which are the intervals of time it takes to get from the initial to final ambient temperature, of locations within the tube and compared this to the data recorded. I am able to use this information to make future predictions about the amount of time it takes to cool the mirror and make suggestions on how astronomers can mitigate the amount of heat surrounding the mirror by modifying the current cooling system. The temperature data analysis at various locations and under different conditions is useful to astronomers so that they can try to lessen the blurriness caused by heat distortion. With this data logging system I hope to contribute to finding a solution to receiving higher quality images for astronomers at the UH 2.2 meter telescope, and to finding a way to have a more efficient chiller system and dome/mirror fans.

Biography:
Jennifer was born and raised in Los Angeles, CA and moved to the Big Island in 2011. In 2007 she received her BA in Illustration where she pursued a career in art and became a teacher and then a tattoo artist for 5 years. Currently, Jennifer is going into her senior year as a Physics and Math student at University of Hawaii at Hilo. After graduation, she wishes to pursue a masters in Astronomy. Jennifer has a strong interest in stellar and quantum physics, but also appreciates engineering and technology. She enjoys taking her 6-year-old son to science museums, surfing, swimming, hiking and martial arts.

Alice Chen
University of Hawaii at Manoa

Site: Akimeka LLC & ASRC Federal – Kihei, Maui
Mentors: Lisa Burleson, Joey Andrews, Desislava Iorgova

Build a Web Application/API Gateway for Data Set Analysis and Validation using GraphQL

Akimeka LLC and ASRC Federal are tasked to maintain the Theater Medical Data Store and Medical Situational Awareness at Theater (TMDS/MSAT) applications, which collects data from deployed military personnel. Duties towards software maintenance oftentimes require data validation for record preservation, developing new features, or integrity checking for bad data. To improve the efficiency of the tasks involved in its maintenance, I wrote an application using GraphQL to connect the different development tiers in the TMDS/MSAT applications. GraphQL is used since its queries only compose of types or objects as opposed to SQL statements, allowing for less verbose queries. This in turn can reduce the time needed to write a query for data validation. A resulting nested query in GraphQL also indicates the relationships between records, while the results of a nested SQL query is a table. With SQL queries, the relationship between tables is not inherently obvious in its results. Using GraphQL is thus expected to increase efficiency in validating data in the TMDS/MSAT applications. The application I created also uses tools such as LoopBack 4 and Apollo Server 2. I used a LoopBack 4 connector to connect to the database and generate models. The models generated map the oracle data to loopback types in order to use the LoopBack 4 Object Relational Mapper (ORM) to query from the database. The LoopBack 4 ORM is then used for resolving how the data is obtained in GraphQL. I used Apollo Server 2 as a server to connect the client to specified data sources. Apollo Server 2 also allows for the setup of GraphQL Playground on the same URL as the server. The GraphQL playground is the client for this application, and is an interface for user interaction with the database. The project also utilized node, fogbugz, and perforce in its production, and was developed using SCRUM, an Agile development methodology.

Biography:
Alice Chen was born and raised on the island of Oahu. She currently attends the University of Hawai'i at Manoa (UHM) where she is pursuing a Bachelor of Science in Computer Science and a minor in Mathematics. At UHM she has interned at the school's newspaper and wrote article briefs for two years, tutored college students in Computer Science and Discrete Mathematics for two years, and participated in a summer leadership program both as a mentee and mentor. She has also served as a senator and a committee Vice-Chair at the student government for a year and in the past year has started a student group for studying and applying algorithms. In her free time, she enjoys drawing, reading, solving programming problems on sites like codesignal as sleeping_parrot, and spending time with her pet zebra dove.

Jonathan Chin
University of Hawaii at West Oahu

Site: Akimeka LLC – Kihei, Maui
Mentors: Peter Konohia III, Rob Nelson

Project Gemini: Identifying and Rating Errors in a Database

The Defense Health Agency (DHA) implemented a project called the Theater Medical Data Store and Medical Situational Awareness Theater (TMDS/MSAT) that combines service members medical data into a unified database for easier access. TMDS/MSAT has a need to maintain integrity while aggregating data. Fat fingering, typos and misinterpretations can lead to multiple versions of what should be the same record. I created Project Gemini to fill this important need. In order to properly design Project Gemini, Scrum agile software development was used for a collaborative and adaptive experience. The project will identify any differences that exist in the last name, date of birth and social security number for every patient record using one of two distance algorithms, Jaro-Winkler or Levenshtein, to flag and assess the severity of the error with a number between 0 and 100. Where 0 means the compared words are completely different and 100 means they are exactly the same. An analysis of alternatives was used to choose which algorithm will be implemented into the project. Ultimately, the Jaro-Winkler algorithm was chosen because of consistent scoring and better performance. Project Gemini uses SQL queries to take the first entry of every patient, which we assume is truth, and every other entry from that patient then compare the two using one of the algorithms and insert the results along with the last name, date of birth and social security number of the corresponding patient into a new table. Project Gemini essentially is a PL/SQL procedure that will periodically check certain demographics for errors and insert those demographics with the resulting score from the algorithm into a table. The algorithm's score will simultaneously help indicate where an error, if any, occurred and the severity of that error. This will effectively help mitigate compromised data from the database.

Biography:
Jonathan Chin is from the island of Oahu and graduated from Kaiser High school. He is currently pursuing a degree in Information Security Assurance at the University of Hawaii at West Oahu. After graduation, his goal is attain a job in the field of cyber security. Outside of work and school, his hobbies include weightlifting and video games.

Royce Nainoa Cornwell
Kauai Community College

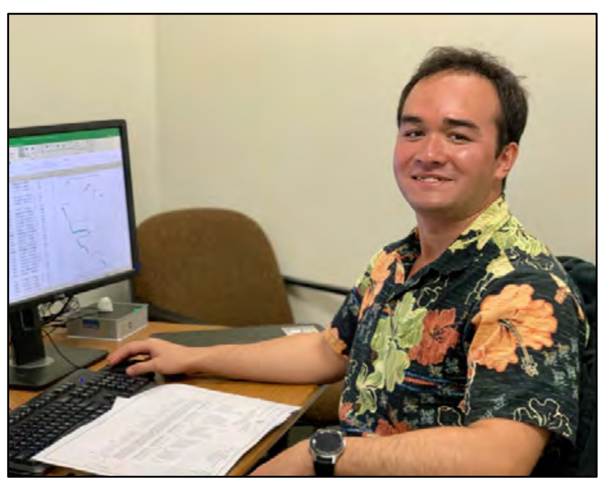
Site: W.M. Keck Observatory – Waimea, Hawaiʻi Island HI
Mentors: Jason Chin, Ed Wetherell, Nick Suominen

Keck I Laser Safety System Upgrade

The Keck Observatory at Mauna Kea houses two ten-meter telescopes, each accompanied with Adaptive Optics technology that uses high-powered sodium lasers to generate artificial stars to support removal of atmospheric distortion from their observations. These Class 4 lasers output sufficient power that can pose a danger to personnel, aircraft, and even satellites upon contact with the beam. To mitigate these hazards, a safety system designed to support ANSI Z136.1 and Z136.6 standards (Safe Use of Lasers Indoors and Outdoors) was implemented to support safe propagation. The safety system consists of a Programmable Logic Controller (PLC) and sensors to determine when it is safe or not safe to propagate the laser beam. It does this by communicating with the laser system via a hardware interface to turn OFF power or close its shutter. The PLC also has an interface allowing the user to monitor the laser status, the temperature of the heat exchanger, and its status of the beam train.The Keck I laser is scheduled for decommissioning and will be replaced by a new laser with higher return and efficiency. My project was to build new hardware, and update the existing software in the safety system to allow the PLC to interface with the new laser and associated infrastructure changes. One new feature that was added to the system is the use of lock-out-tag-out (LOTO) switches. The main purpose of the LOTO switches is to improve personnel safety by disabling laser functions (e.g. laser power via shutters) and prevent them from turning back on in case personnel need to make adjustments to alignment, troubleshoot problems, or replace parts in the laser. I began by reviewing the project requirements, previous safety system designs and making changes to the existing designs. After planning the wire layout for the new hardware, I built the new wiring and cable assemblies to be installed with the existing PLC. While assembling & connecting wires, it was important to be consistent with color coding for wires, otherwise a 'Laser status ON' button might have been mis-wired with an 'Emergency STOP' button. In order for both the existing and new hardware to communicate with the laser, the PLC software (ladder logic) needed to be reviewed and updated as well. One major challenge was to ensure the existing safety system parameters are maintained while introducing new functionalities. If the existing parameters were changed incorrectly, it would negatively impact the safety system functions and performance. Careful testing and documentation was necessary to avoid errors such as incorrect connectors in wiring diagrams, or software code issues. During integration and testing, these errors were addressed, and the new hardware is able to communicate with the safety system successfully. By the time the new laser is installed in October, the safety system will be ready to operate with it improving telescope observations.

Biography:

Royce Nainoa Cornwell was born and raised on the island of Kauai. He has always been interested in science and mathematics. He has earned an Associate in Science Degree in Electronics at Kauai Community College and is currently enrolled at the University of Hawaii Manoa pursuing a Bachelor's Degree in Electrical Engineering. After graduation, he plans to find a career in optics or electro-physics in Hawaii. Eventually he also plans to earn a Master's Degree in Electrical Engineering. As a native Hawaiian, he aspires to bring innovation to the state of Hawaii. He has studied abroad in Japan for one year to cultivate his communication in Japanese. In Kauai Community College, he was the President of Phi Theta Kappa Honor Society and tutored students learning electronics and mathematics for 2 years. His hobbies include, playing video games, practicing piano, learning Japanese/Chinese language and studying astronomy.



Dash Cotton
Gonzaga University

Site: Daniel K. Inouye Solar Telescope (DKIST) – Pukalani, Maui
Mentors: Chris Gedrites, Shawn Haar

Developing the DKIST Maintenance Management System

The value of DKIST revolves around its ability to produce useable scientific data. Preventive maintenance minimizes potential downtime by addressing incipient failures, thereby optimizing the telescope's utility. To meet these operational expectations, DKIST requires a comprehensive preventive maintenance program. Ideally, the program will help users avoid the frustrations that accompany component failure due to unorganized and inefficient maintenance. My project involves the extraction of relevant manufacturer maintenance guidelines, and the use of these guidelines to create a prioritized list of maintenance tasks. I accounted for estimated asset downtime due to failure and scheduled maintenance to calculate total downtime per year for each system. This enabled me to help determine how many technicians are needed to fulfill proper maintenance requirements while remaining in accordance with DKIST reliability specifications. Thus, limited personnel on the summit will not negatively impact the functionality of the telescope. Using Dropbox, I compiled relevant maintenance information (troubleshooting, access instructions, etc.) into folders corresponding to each system of the telescope. Preliminary (and incomplete) data shows that to achieve 14 days of downtime, 14 technicians working 8 hour shifts throughout the year would be required. Eventually the excel data will be transferred to a more user-friendly computerized maintenance management system where it will be continuously updated in accordance with current (and more realistic) time estimates.

Biography:
Dash Cotton was born and raised in Waimea on the Big Island of Hawaii. He is currently pursuing a major in Engineering Management at Gonzaga University. At Gonzaga, Dash serves on the Board of Directors of the American Society for Engineering Management. Upon graduation, he hopes to work towards a project management position at a civil engineering firm in Southern California. However, he hopes to someday return to Hawaii to continue his career. Outside of school, Dash is a executive board member for the Spokane Chapter of Theta Chi Fraternity, where he held the positions of chapter secretary and recruitment chairman. In his leisure time, Dash enjoys surfing, skating, and hiking.

Queenique Dinh
University of Southern California

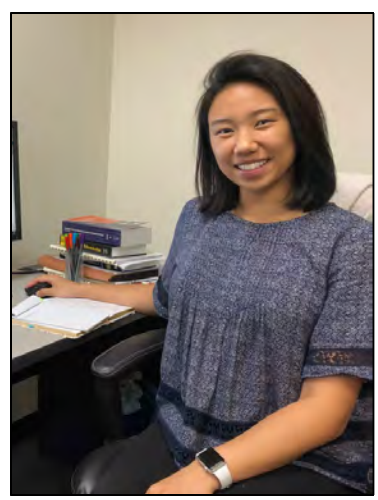
Site: Centauri – Pacific Defense Solutions, LLC – Kihei, Maui
Mentor: Dr. C. Channing Chow II

Cislunar Transfer Trajectory Study

The focus of this work is to find transfer trajectories between near-Earth orbits and families of periodic orbits localized in the Earth-Moon (i.e. cislunar) neighborhood. Certain simplifying assumptions are required to do so. The first assumption is that the cislunar space is characterized by employing the Circular Restricted 3-Body Problem (CR3BP), which describes the motion of a body with negligible mass under the gravitational influence of two primary bodies moving in circular orbits around their barycenter. In this highly idealized dynamical system, the equations of motion produce five equilibria, also known as libration or fixed points, that remain in their positions relative to the two primaries as the system rotates. The families of periodic orbits emanate from these libration points. In this study, AUTO-07p, a numerical continuation and bifurcation software, is used to generate the families of periodic orbits, specifically those around the stable L4 and L5 libration points. The initial conditions from AUTO-07p are then ported to MATLAB to find transfer trajectories. The second simplifying assumption is that the potential transfer trajectories are found by considering only the Keplerian orbital elements (e.g. eccentricity and semi-major axis) as solved for by using Lambert's problem, a type of two-point boundary value problem. The results of this study can serve as reference solutions for higher fidelity models with additional perturbations, such as the gravitational effects of other major bodies. With a growing revival of interest in returning to the Moon, this study provides insight into creating pathways that connect traditional near-Earth orbits to periodic and/or quasi-periodic orbits in cislunar space.

Biography:

Queenique Dinh is a graduate of Moanalua High School, but was born in California and raised in Virginia before moving to the island of Oahu. Continuing the passion for space she fostered at a young age, Queenique is majoring in astronautical engineering at the University of Southern California and is particularly interested in orbital mechanics and space mission design. At school, she serves as an executive board member for USC's chapter of the American Institute of Aeronautics and Astronautics. Outside of academics, Queenique is also an executive board member for the SC Ballroom and Latin Dance Team. She enjoys practicing American Smooth dances and competing in Southern California's collegiate dancesport scene.



Jack Hershey
Lewis and Clark College

Site: Academia Sinica Institute of Astronomy and Astrophysics – Hilo, Hawaiʻi Island
Mentor: Ranjani Srinivasan

YTLA Database Retrieval and Visualization Web Application

The Yuan Tseh Lee Array (YTLA) is a radio interferometer, which means it has multiple signal pathways whose operational parameters need to be tracked to ensure that their performance is optimal. The gap that I am trying to fill in operations, is the lack of aforementioned data access from the YTLA logs. The project seeks to display datastreams originating from the telescope and present them as interactive timeseries graphs that can be changed depending on the parameters selected and are displayed on a webpage that any ASIAA staff can use. I created a software suite using python that can extract, parse and plot data quickly and effectively. In addition to creating the framework, I implemented ease of access which includes an easy to understand user interface, text documents with complete accompanying documentation where new variables and notes can be inserted and immediately displayed on the webpage. This eliminates the need for astronomers to search through the actual code when they decide to track/add a new variable. I essentially created a new piece of software that allows ASIAA to quickly retrieve data from the telescope remotely via web access and the capability of easily modifying variables and notes without having any coding experience.

Biography:
Jack was born and raised in Kailua, Hawaii. He went to the mainland for college and goes to Lewis and Clark college in Oregon. Jack has always been interested in programming and computers and is a Computer Science and Mathematics Major. Jack enjoys video games/board games as well as reading sci-fi books. He hopes to get more experience in the field and get a job involving programming of some kind preferably software engineering.

Jay Ryan Jamorabon
University of Hawaii at Manoa

Site: Subaru Telescope – Hilo, Hawai'i Island HI
Mentors: Shintaro Koshida, Philip Tait

Development of an Integrated Status Monitor for the HSC

The Hyper-Suprime Cam (HSC) is a large mosaic CCD imager instrument for the Subaru Telescope. It's one of the main instruments for the organization because it's so actively used—it takes up roughly 40% of Subaru's observation time—and it yields very significant scientific results. It runs on a complex system with many components and electronics that cooperate to produce rich images of the night sky. However, operating and monitoring the instrument during observation are difficult tasks for astronomers because of its command-line interface (CLI) and the need for manual inspection over a remote SSH connection. Users are required to type complicated commands to access important information and tools that are scattered throughout the system which can waste valuable observation time for the organization. To enhance operations, I developed an integrated status monitor for the HSC. It implements a graphical user interface written in Python to replace the instrument's CLI. The graphical components such as the window, buttons, and tables are rendered using the Tkinter toolkit to avoid importing third-party packages that may impact the network and system performance. The software also provides centralized status monitoring functionality by integrating all the necessary information and pre-existing tools in one program. This feature automates the process of monitoring the shutter position, filter exchange unit, and read-out status for the astronomers. The software was tested during a mock observation in which astronomers performed normal observational procedures with a noticeable decrease in time dedicated to monitoring and minimal impact to the system's performance. Upon completion, the integrated status monitor will save the Subaru Telescope valuable observation time and optimize procedures for current and new operators of the HSC.

Biography:
Jay is a sophomore studying Computer Science - Security Science at the University of Hawaii at Manoa. He was born and raised on the island of Oahu in Hawaii. As a child, Jay developed a deep interest in computer systems, networking, and cyber security that has stuck with him to this day. He currently works for the University of Hawaii Information Technology Services where he helps maintain and operate the university's main data centers. After graduating, Jay hopes to work in the field of cyber security and become a security engineer or researcher.

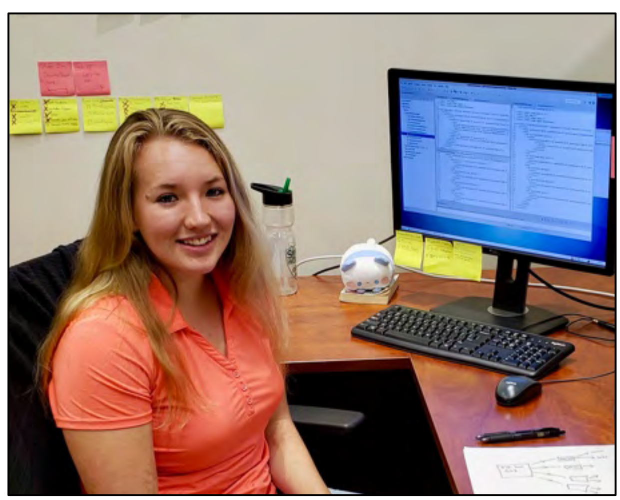
Katherine Jefferson
Drew University

Site: Daniel K. Inouye Solar Telescope – Pukalani, Maui
Mentors: Stephen Guzzo, Keith Cummings

Engineering a Low-Level GUI for the Telescope Mount and Coude at DKIST

The mount system in the solar telescope provides the support and rotation of the mirror assemblies, and the coude helps to de-rotate the light for delivery to the instrument systems. To control the mount and coude, there was already a low-level GUI in existence. However, it ran on a dated version of windows while the rest of the system ran on Linux. In addition, DKIST also did not own the source code and thus could not modify it. Thus it was determined that an entirely new low-level GUI was essential for the continued operation of the telescope. In order to build a new interface, we were able to analyze the existing GUI, and split it into its relevant and extraneous parts. We worked on a centos 7 virtual machine with e(fx)clipse, and started by prototyping the layout of the GUI in javafx. Concurrently, we decided that the best way to connect that javafx interface to the mount and coude systems was to use a socket. This method of connection functions similarly to how a thread connects the two cans in a tin can telephone, enabling one to talk to the other. In order for a client (the GUI) to talk to the server (the mount/coude systems), there needs to be a socket that can plug into the server from the client. Similarly, if the client needs to listen to the server, I need another thread in the opposite direction. A GUI with these traits will allow the system controls engineer at DKIST to receive information from the hardware and actively be able to input commands for the purpose of testing, tuning and maintaining the mount and coude systems.

Biography:
Katherine grew up on the Big Island and graduated from Hawaii Preparatory Academy in 2016. She is currently going into her senior year at Drew University in New Jersey. She is majoring in Computer Science and minoring in Mathematics. Katherine is a member of both the university's swimming and golf teams. In her free time, she likes to relax on the beach with friends.



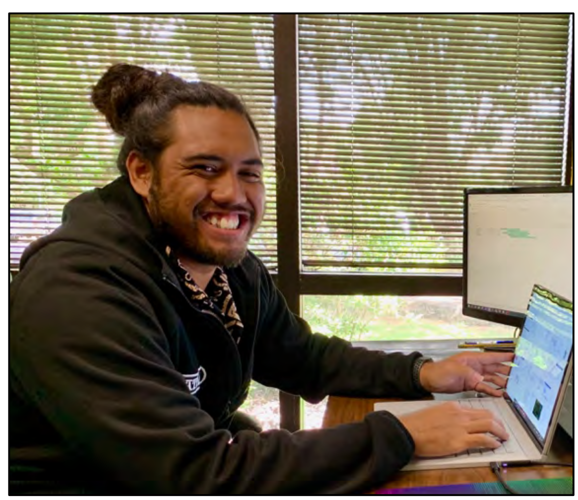
Kaiaka Kepa-Alama
University of Hawaii at Manoa

Site: Canada-France-Hawaii Telescope – Waimea, Hawai'i Island HI
Mentors: Ivan Look, Grant Matsushige

Mitigating Ice Collection on Dome Vent Door to Increase Operational Efficiency

Temperature variations within the earth's atmosphere cause visible light waves to scatter due to the change in its refractive index. Monochromatic light from space scatters when it enters earth atmosphere. This interaction distorts the incoming wavefronts of light causing an image to appear blurry. Isothermal conditions within the Canada-France-Hawaii observing dome is essential to improving image quality. Vents implemented on the exterior skin of the rotating dome allow for ambient air to flow inward, cooling the observatory and decreasing the existing temperature gradient to within a degree centigrade. The dome vent door, serves as the protection barrier from adverse weather conditions; however, it has an issue with ice forming within the door slats. Ice formation in the door slats prevent the door from closing properly; causing it to unravel from the drum. There is a need to mitigate the amount of ice collected to increase proper door function. Several features have been evaluated and shall be designed to decrease ice collection without ruining the integrity of the operation of the dome vent. A proposed solution would entail implementing a heating element to mitigate ice through convectional heat transfer. Validation process includes the integration of sensors to calculate the rate of heat transfer, energy usage and control system optimization. Testing would occur in an environment with conditions similar to the summit. It is crucial that various factors such as power, radiating temperature, operational maintenance, and fabrication be taken into consideration during the design process as they have a profound effect on the budget, size, and location of the design feature. A working prototype was designed, fabricated, and tested to help understand and correct proper operation of the dome vent.

Biography:
Kaiaka Kepa-Alama was born in Halawa, Oahu and graduated from Saint Louis School. He is currently a senior at the University of Hawaii at Manoa majoring in Mechanical Engineering. His career goal is to hold a decision making position that benefits both the innovations in science as well as the advancement of the Hawaiian people. Kaiaka enjoys fishing, going to the beach, and playing slack key guitar.



Johnathan Kuamoo
University of Hawaii Maui College

Site: SMA/ASIAA – Hilo, Hawai'i Island HI
Mentors: Peter Oshiro, Derek Kubo

Replacing the Cryogenic Temperature Sensors for YTLA Radio Array

SMA/ASIAA has a radio array located on Mauna Loa called YTLA, which has 7 antennas. Each antenna needs a receiver to reduce electrical signals from the atmosphere and heat contributing to radio noise. The receivers are cryogenically cooled to reduce noise, but to reduce the interference there are Low Noise Amplifiers (LNAs) that amplify the correct signals being sent to the antennas. The problem is that the temperature sensors on the receiver are not working, making it impossible to tell if the receivers are being cooled to 10 Kelvin. Next, since the sensors are new, and come with a Lakeshore monitor, there are two sets of information coming from the receiver. One set will go to the Lakeshore monitor and the other set is from the LNAs that amplify signals to go to an electronic distribution box that sends signals from the antennas to SMA/ASIAA's computers. For the temperature sensors, we installed the new sensor called the DT-600 series and took out the old sensors. To check the sensors, we cryogenically cooled the receiver and then used the Lakeshore monitor to test if the sensors are working. To create the cable, we separated the wires that contained information to reduce noise and of the temperature readings using a breakout box. The Lakeshore monitor revealed correct installation, showing that the LNAs in the receivers were cooled to 10 Kelvin. With the results of the project, SMA/ASIAA will be able to ensure that their receivers are being cryogenically cooled correctly. Using the new temperature sensors and cable design, they can use the first receiver as an example to integrate the new sensors into the rest of the receivers.

Biography:
Johnathan Kuamoo is from the island of Maui where he graduated from Kamehameha Schools Maui in 2016. Currently, he is a Junior attending the University of Hawaii Maui college to pursue a bachelor's in Engineering Technology. Johnathan hopes to become an Electrical Engineer after earning his degree. In his free time, he enjoys playing video games, taking care of his animals and trying to work out.

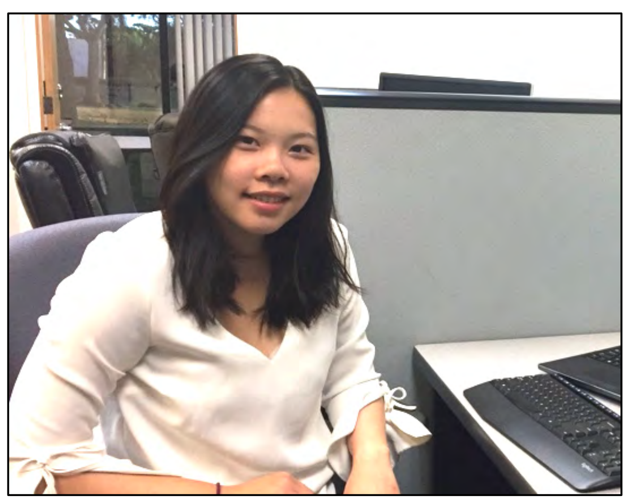
Jenna Lau
University of Southern California

Site: Centauri – Pacific Defense Solutions, LLC – Kihei, Maui
Mentors: Greg Martin, Oliver Grillmeyer

Interpretability of SatNet Machine Learning Model

Several government observatories around the world use telescopes to periodically collect images of space to track the locations of various satellites in geosynchronous orbit (over 22,000 miles from the earth's equator). Deployed around the world, Astrograph, a computer vision software tool, is currently used to identify and locate satellites from data acquired by telescopes in near real time. However, under certain conditions, Astrograph has difficulty in correctly detecting satellites. For example, when substantial flare light is present, such as from an automobile headlight, Astrograph can incorrectly predict the presence of satellites when there are none. In order to improve the accuracy of classification and localization of satellites, a machine learning model is being developed to more accurately classify and locate unresolved satellites in images from tracking telescopes. One model being evaluated is YOLOv3, a state of the art real-time object detection algorithm, that uses a deep convolutional network to classify and locate objects in images. This project utilizes SatNet, a labeled dataset of satellite images recorded by Astrograph, to train a YOLOv3 model. My project involves visualizing some of the performance attributes of this convolutional neural network and interpreting the model's results to gain insight into how the model is detecting and locating satellites by integrating various methods for backpropagating and calculating gradients to generate saliency maps. These visualizations and their implications will be presented at the Final Symposium.

Biography:
Jenna is an incoming sophomore at the University of Southern California majoring in computer science. Raised on the islands of Maui and O'ahu, she graduated as valedictorian from 'Iolani School's class of 2018 and is a research assistant at USC Melady Lab. Outside of the classroom, Jenna enjoys snowboarding, cooking, and riding motorcycles.



Ethan Lee
Cornell University

Site: Institute for Astronomy – Pukalani, Maui
Mentors: Dr. Jeff Kuhn, Dr. Andre Fehlmann

Characterizing Data Ramp Non-Linearity and Correcting Bad Pixels for CryoNIRSP

The Institute for Astronomy on Maui is currently building CryoNIRSP, an instrument that will be placed inside the Daniel K. Inouye Solar Telescope for measuring the Sun's magnetic field. In order to gather information on the Sun, the instrument uses a sensor which measures light intensity. This data is taken in the form of Non-Destructive-Reads, which read the voltage of the sensor without resetting the voltage of the sensor. Data taken in this way is called a ramp. My project involves finding characteristics of the linearity of these ramps, and learning more about the characteristics of different pixels. We are characterizing the linearity of the ramps through measurements of linearity over simulated changes in brightness level, and hope that this characterization of the linearity also distinguishes defective pixels. We are also attempting to remove the non-linear part of the ramp using a threshold created through observations of ramp linearity. Results of our ramp and pixel studies will be presented. Eventually, by characterizing the linearity of the ramps of both good and bad pixels, we hope to gain the ability to distinguish bad pixels and also establish criteria for correcting for the non-linearity of all the ramps, and through this, improve the accuracy of the data taken with CryoNIRSP.

Biography:
Ethan Lee is currently a Junior at Cornell University pursuing my degree in Physics. His goal is to use his degree to do physics and better understand the world around us. He also is interested in teaching Physics. Ethan was born and raised in Honolulu, HI and graduated from Punahou High School. In his free time, he enjoys surfing, competing in broccoli-eating contests, playing trumpet, and staying rat lung-worm free. He has always loved the sciences and especially physics and can't wait to expand his knowledge in the field further.

Kasey Matsumoto
Hawaii Community College

Site: W. M. Keck Observatory – Waimea, Hawaiʻi Island HI
Mentors: Matthew Brown, Shelly Pelfrey

Recording and Retrieving Outreach Statistics through a Web Application and Database

The W. M. Keck Observatory Outreach Committee attends public events and invites the public into its Waimea Headquarters to educate the community on Astronomy and STEM disciplines. Various topics and activities such as science talks, hands-on demonstrations, and telescope viewing are provided to small and large groups year round. Information on each event is tracked so that they can be used to help find donors as well as verify that effort is being reported appropriately. Originally, outreach information was tracked through a web application and backend database. The old web application was deemed hard to use as various forms needed to be filled out and it requested inessential information. It also displayed information inefficiently by viewing all events or viewing them by their event status like denied, cancelled, or approved. The Outreach Committee had been temporarily recording information into a spreadsheet but a more efficient solution was necessary. As a database can increase data retrieval efficiency, my task was to create a new web application and backend database that makes recording and retrieving information easier. Instead of filling out multiple forms, outreach event information is entered and updated through a single webform and submitted to be recorded into the backend database. As opposed to viewing information by their event status, outreach event information is displayed based on various categories such as the events requested by a specific organization or the events within a date range. Calculated reports relating to the categories are also displayed on the web page such as the total number of events or participants. HTML and JavaScript, which are client-side scripts, are used to control how the application is presented while PHP, a server-side script, is used to store and retrieve information from the MongoDB database. With this new system, the Outreach Committee will have an easier time recording and updating event information as well as retrieving useful reports.

Biography:

Kasey Matsumoto was born and raised on the Big Island. She studied in Computer Science at UH Hilo before later switching over to Hawaii Community College where she received her A.S. degree in IT this past spring. She loves a good story and in her free time she reads, watches TV shows, as well as plays RPGs. She also enjoys creating digital art and writing stories. One of her major goals is to create visual novels on her own using her art, writing, and scripting skills. She also plans to continue her education and receive a Bachelor's degree.

Olivia Murray
University of Hawaii at Manoa

Site: Gemini Observatory – Hilo, Hawaiʻi Island HI
Mentors: Jerry Brower

Planning, Executing and Evaluating an Information Security Incident Response Preparedness Drill

In order to sustain itself, the Gemini Observatory relies on its ability to maintain various services, such as access to Gemini accounts and resources, for both internal users and the astronomical community. If there is ever a security incident such as a breach or event that compromises or has the potential to compromise any Gemini information asset, personnel must follow the Incident Response Procedures. The Incident Response Procedures is a document containing what to do during such an event. This document recommends that there are to be unannounced simulated incidents at least annually to test these procedures. The first time these procedures are put in place must not be during an actual incident. The purpose of this project is to examine these procedures and create the first incident response preparedness drill, execute and analyze the results of the said drill, and propose changes to the Incident Response Procedures including instructions to conduct future drills. Different incident scenarios and different approaches as to how to perform the simulation were proposed to the ITS staff. We decided to simulate a Distributed Denial of Service (DDoS) attack on the Gemini External Website. The simulation was conducted in a manner to test if the procedures are clear, accurate, and effective, as well as observe the communication between parties, but not test the technical capabilities of staff members. Post-simulation, a meeting was held to collect feedback and input to improve both the simulation and procedures. We concluded that future simulations should not be completely unannounced, and more indicators of compromise should be sent to staff. As for changes to the procedures, a use-case scenario was created for incidents involving the Gemini External Website, and more communication paths were added to keep others informed, such as other observatories, the University of Hawaii, and the MKO Crisis Communications Working Group. These changes will improve the overall process of handling an incident, as well as improve future simulations. Gemini can use these lessons learned to continuously try to update and improve these procedures.

Biography:
Olivia was born and raised in Hilo on Hawaii Island. She graduated from Waiakea High School in 2016 as a valedictorian. She is a Regents Scholarship recipient at the University of Hawaii at Manoa where she is an Honors student majoring in Computer Science with a focus in Security Science. This is her second year in the Akamai program. She currently works with the Center on Disability Studies on the Ka Pilina grant, writing and testing math and science lesson plans for grades K-8. She is also a college consultant with NexTech where she helps plan and run STEM workshops. After graduating, she hopes to enter the field of Cyber Security. In her very limited free time, Olivia enjoys roller skating and participating in roller derby and inline hockey.

Briana Noll
University of Hawaii at Hilo

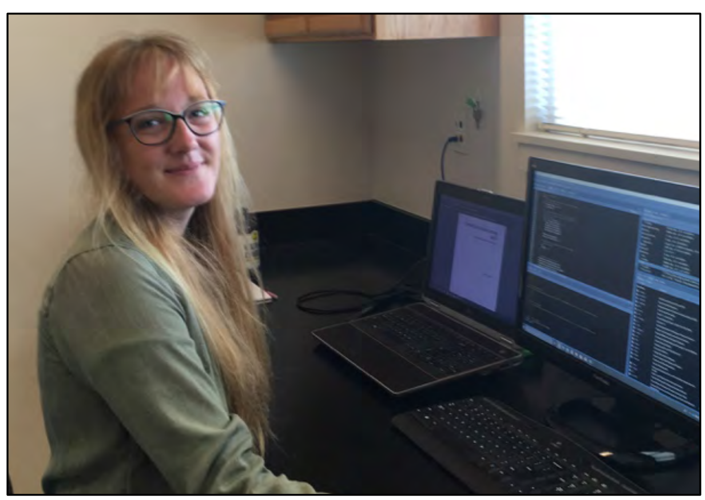
Site: Cyanotech – Kona, Hawaiʻi Island HI
Mentors: Court Warr, Charles J. O'Kelly

Microscopy Image Classification Using Machine Learning

Imaging flow cytometry (FlowCam: Fluid Imaging Technologies, Portland, ME) provides image analysis of particles found in aquatic samples. By correctly identifying the particles and their relative proportions within the samples, researchers and cultivators at Cyanotech Corporation can find trends and patterns that help to increase the productivity of spirulina (*Limnospira fusiformis*), a cyanobacterium commonly used as a dietary supplement. Cyanotech would like to know if applying a classification algorithm will perform more accurately than the existing classification method and reduce the manual classification process which can take up to 30 minutes per sample to complete. The FlowCam maps image samples and converts the images into numerical data, producing a spreadsheet of each image's unique properties. To build an accurate model that contained little bias and overfitting, it was important that I extract and build a balanced training data set. I exported historical data from multiple spreadsheets and developed a training set by randomly pulling annotated data from the most common particles, then reduced the dimensionality of the feature space by discarding redundant and unnecessary variables from the dataframe. Each remaining variable was then scaled to prevent the model's failure to generalize data due to high variance. Several classification methods were built with the training set then tested with a separate dataset. Out of these models the top three performers, support vector machine, k-nearest neighbor, and random forest, were selected for further analysis. Each model was then tuned in the attempts to improve accuracy. Once the top performing model is determined, it will automatically write classification data to the existing FlowCam database. Cyanotech will utilize the classification model if it performs better than the original classification method. Results of the best performing classification model will be presented.

Biography:

Briana grew up in Seattle, WA before moving to the Big Island in July 2017. She is a rising senior enrolled in the computer science program at the University of Hawai'i at Hilo. After graduating, she plans to attend graduate school to further her education in computer science. When she is not writing code she enjoys exploring the Big Island, cooking for her family and designing video games.



Keakealani Pacheco
University of Hawaii at Hilo

Site: Air Force Research Laboratory (AFRL) – Kihei, Maui
Mentors: Capt. John Schmidt, 1st Lt. Richard Peterson, and Lt. Col. Scott Pierce

Air Force Astronomical Metrics Software Accessibility Testing and Documentation

The Dynamical Optical Telescope System (DOTS) team, with its contracted partners, developed an astronomical metric software called AstroGraph. AstroGraph uses stars as fixed points in order to identify objects in space. The Air Force Research Laboratory (AFRL) gave me the task of testing AstroGraph and documenting issues needing correction and consolidated into a solution manual for use by other government organizations. Many factors lead to problems for new users, for example, updates in open source libraries, operating system errors, and lack of assumed knowledge. Software engineers who have an extremely in-depth understanding of the software and its Linux environment wrote the current AstroGraph documentation. Therefore, a lot of instructions tend to be less thorough due to numerous details being assumed knowledge. In order to be successful in my task, I must close the gap between the current version and one for a novice user. I personally installed, trained with, and used AstroGraph, which gave me personal insight into issues that other non-expert users would face. One challenge unique to my testing involved operating the software through a virtual machine. Installing AstroGraph on a virtual machine with a Linux operating system is a constraint of the military, being that AFRL works under a protected network. I had no access to a working standalone Linux machine within their vicinity. This made the testing process more challenging, considering that I now dealt with virtual machine issues as well. Despite this challenge, I documented and gauged the difficulty of the operation within these limitations and pointed out the software's flaws in terms of usability. A clear indication of my success will be a well-documented set of instructions along with troubleshooting expertise, as well as being able to present and teach AstroGraph to the AFRL research team. My documentation will lower the integration cost incurred by the government during software development by creating an easier set of instructions that can be available for distribution.

Biography:
Keakealani Pacheco is from Pāhoa, Hawaiʻi and graduated from Kamehameha Schools Hawaiʻi in 2016. She is going into her senior year of college at the University of Hawaii at Hilo, in hopes to pursue a BS in Computer Science. After graduation, she plans to use her degree to give back to the community that she grew up in. Along with her interest in computer science, she enjoys practicing aloha ʻāina, community building, and spending time with her friends and family.

Aliyah Pana
Central Washington University

Site: Canada-France-Hawaii Telescope – Waimea, Hawaiʻi Island HI
Mentors: Windell Jones-Palma, Simon Prunet, Tom Vermeulen

Cassegrain Astrometric Camera Characterization Using Distortion, Pointing and Focus Models

Due to Canada-France-Hawaii Telescope's (CFHT) relatively narrow field of view SPIRou and ESPaDOnS instruments, CFHT's telescope pointing accuracy is essential to maintaining a high level of observing efficiency. Due to inaccuracies in the CFHT's pointing models, having complete certainty in which target to observe is sometimes difficult. Use of star finding charts aid the observers in acquiring the correct target, however this method is prone to human error and interpretation. To overcome these errors, an astrometric camera has been developed at the CFHT to increase the observing efficiency while these narrow field of view instruments are being used. An astrometric analysis of the images taken by this camera, during observing, can be used to determine the pointing direction of the telescope to much greater accuracy and less time than methods that are currently employed. However, to achieve a high level of accuracy, the astrometric camera was characterized. This characterization is performed by analyzing a set of images to extract several key parameters. For such a camera it is essential that the following parameters be determined: pixel scale, field of view, pointing model, image distortion model, and focus model. To estimate all of these models, a least squares minimization approach was taken for each model. As a result, all of these models were estimated in a purely empirical fashion with a high level of accuracy. With these parameters estimated, the astrometric camera would be deemed thoroughly characterized and can be integrated into CFHT's observing operations. This work summarizes the estimation process for characterizing the CFHT astrometric camera.

Biography:
Aliyah was born and raised on the Big Island. She graduated from Hilo High school. She is recently earned her Bachelor's of Science in Applied Mathematics at Central Washington University. She will be returning to Central Washington to pursue a Master's of Science in Information Technology and Administrative Management with concentration in Data Analytics. In her free time, she enjoys going to the beach, playing basketball, and hanging out with her family. She hopes to pursue a career in Sports Statistics.

Jaynine Parico
Kapiolani Community College

Site: PISCES – Hilo, Hawaiʻi Island HI
Mentors: Christian Andersen, Rodrigo Romo

Designing and Constructing a Constant Tension Reel for UAV Tether

Within the last 2 years, PISCES has been working on a County project, from the Hawaii Department of Research & Development, to reduce populations of Little Fire Ants (LFA). These LFA's are classified as an invasive species in Hawaii and are prevalent here on the Big Island. LFA's are an ongoing problem to local nurseries and negatively affect local agriculture, ranching, and tourism industries. In addition to their painful sting, they are known to nest in tree canopies and other inconvenient places such as potted plants and irrigation lines. Utilizing an Unmanned Aerial Vehicle (UAV) offers a simple solution for aerial delivery of LFA pesticides. The current UAV is capable of carrying up to twice its weight, but payload may require additional support, such as a tether system. In order to offload payload mass, the UAV will need a grounded tether system that retrieves/feeds pesticide and provides constant tension while in flight. Managing the UAV and ensuring that the tether is not kinking or tangling can be problematic. In order to compensate for tension or slack on the line, we have designed a reel that functions through a PID controller written in C and C++. Prototyping involved a simple spool attached to a motor on one end and a hose swivel joint on the other. The motor is controlled via Arduino, motor driver (H-bridge) and a current sensor. These devices help incorporate PID functionality for both input and output data. As tension increases or decreases on the line, this affects motor torque which proportionally increases or decreases the voltage across the motor. A successful design of the constant tension reel will not only function for LFA control but can provide solutions for UAV deployment on biologically and culturally sensitive caves or even the moon where unknown areas such as lunar lava tubes are safer to assess via drones. These drones will have to be connected by a tether system (as GPS and communications systems are not readily available on the moon nor terrestrial caves and lava tubes) for power and communication access.

Biography:

Jaynine was born and raised on Saipan, an island of the Commonwealth of the Northern Mariana Islands. She moved to Honolulu, Hawaii to pursue a college education. From there she received an Associates in Natural Science with a concentration on Physical Sciences at Kapiolani Community College (KCC). At KCC she was also a member of the Engineers for a Sustainable World (ESW). Jaynine plans to pursue a degree in Mechanical Engineering at the University of Hawaii at Manoa. Her academic interests include aerospace technology as well as renewable energy. On her free time, she enjoys aquascaping, photography, playing the piano and reading.

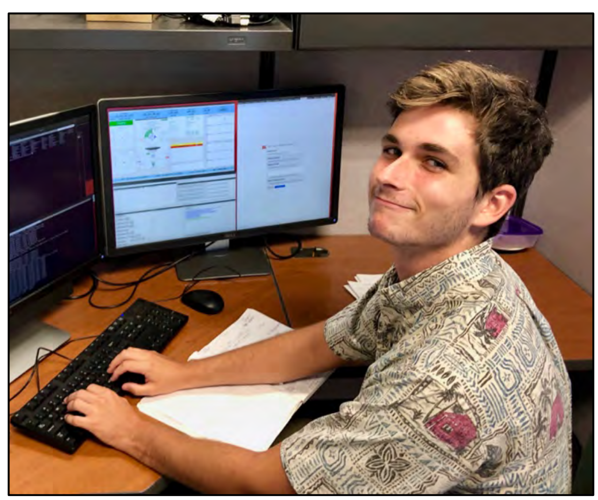
Nick Rosenberg
University of Hawaii at Hilo

Site: Subaru Telescope – Hilo, Hawaiʻi Island HI
Mentors: Russell Kackley and Eric Jeschke

Implementing the Subaru Telescope Simulator Software (TELSIM) in Python3

At the Subaru Telescope on Mauna Kea, astronomical observations are conducted using command scripts that are passed through Subaru's Gen2 observation control software. These commands are then sent to proprietary software to control subsystems such as telescope mount drive motors. Encoders would then provide status information. such as telescope position to the Gen2 interface. To ensure that scripts run as intended, testing them is beneficial. Currently, testing requires usage of the real telescope, which takes valuable time and resources to the point that testing is rarely conducted. Furthermore, creating an isolated test environment using the proprietary control framework is not possible. To make testing feasible and to provide a training environment for new operators, we have used Python3 to develop the Subaru telescope simulator (TELSIM). For TELSIM, I modeled and implemented each major component of the telescope control system as software components, building upon the requirements as laid out by the Subaru Telescope software team. These requirements included the simulation of mount rotation, focus selection, instrument rotation and tracking/autoguiding. Modeling each component required careful communication with system operators to understand the behavior of functionality and to validate our implementation. For more complex component behaviors, telescope observation logs were parsed for status patterns and reverse engineered based upon well-known astronomical concepts. In place of the Mitsubishi control structure, TELSIM interfaces with Gen2 to simulate the behavior and status of the Subaru telescope. As the Gen2 interface remains untouched, users can seamlessly operate TELSIM as if controlling the Subaru Telescope using the aforementioned command scripts. Upon completion, TELSIM demonstrates not only a promising platform for testing observation scripts, but also for training support astronomers and telescope operators.

Biography:
Nick was born and raised on the Big Island of Hawai'i, and is in the senior year of his computer science degree at the University of Hawai'i at Hilo. He has entrepreneurial ambitions, is a big proponent of natural conservation and hopes to utilize computer science in a way that is beneficial to his local and global communities. His auxiliary interests include music production, audio engineering, surfing and filmography.



Kiyomi Sanders
Kapiʻolani Community College

Site: Thirty Meter Telescope: WFOS – University of California, Santa Cruz
Mentor: Renate Kupke

Developing the WFOS Instrument Throughput Budget and Evaluating Optical Coatings and Materials

The Wide Field Optical Spectrograph (WFOS) is the first optical spectrograph of the Thirty Meter Telescope. Its slit-mask design and large wavelength range (310-1000 nm) allows it to collect data from up to 100 objects simultaneously and observe large portions of the universe at a time. WFOS science cases include galaxy population studies, intergalactic medium tomography, and high-redshift studies. WFOS is currently in the conceptual design phase, in which the team is evaluating design options that will minimize loss of the light collected by TMT. This project focuses on determining the WFOS throughput budget, which quantifies the overall percentage of light gathered by the instrument at each wavelength. In order to pursue the expected science cases, the throughput should be >30% across the full WFOS wavelength range. I used Zemax optical design software to analyze each optical element of the design and the factors that affect the percent of light that they either reflect (for mirrors) or transmit (for lenses) across the wavelength range. Some elements had unknown transmission/reflectance curves, and required measuring witness samples with a spectrophotometer. I designed an Excel spreadsheet that includes reflectivity/transmissivity vs. wavelength data tables for every element of the optical design and the material/coating options for each element. I then calculated the total throughput by multiplying the percent of light reflected/transmitted by each individual element in the instrument. I linked the data tables to the throughput calculations so the design team can easily adjust aspects of the design and determine how the total throughput is affected by these changes. The throughput budget will allow us to make predictions about the throughput of WFOS vs. wavelength and determine which design maximizes throughput while still being technologically and logistically feasible. The instrument simulation team will use our results for the exposure time calculator, which will determine specific science objectives WFOS will be able to deliver.

Biography:
Kiyomi Sanders was born in Honolulu and grew up moving between Oʻahu, the continental US, and Scotland. She has recently earned the Associate in Science-Natural Science degree at Kapiʻolani Community College. She is currently participating in supermassive black hole research and is a physics and math peer mentor at KCC. In Fall 2019, she plans to transfer to UH Mānoa and pursue a Bachelor of Science in Physics with a minor in astrophysics. She is interested in many STEM-related fields, including particle physics, cosmology, sustainable engineering, and STEM outreach. After graduating from UHM, she would like to pursue a PhD in Physics and a career in research. In her free time, Kiyomi enjoys reading books and comics, playing music, and writing.

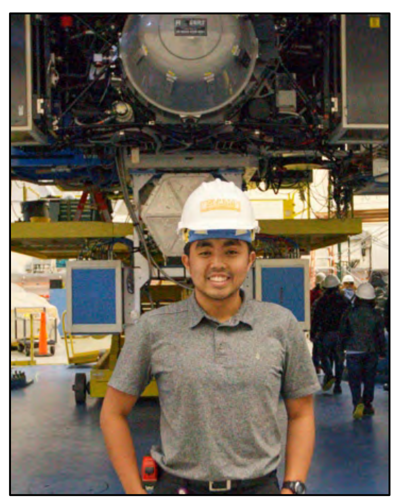
Logan Sato
Oregon State University

Site: Gemini Observatory – Hilo, Hawaiʻi Island HI
Mentors: Chas Cavedoni, Stacy Kang

Mechanical Design and Analysis of a Mount Assembly for the Gemini North Adaptive Optics Laser Launch Telescopes

Gemini North has embarked on a program to upgrade its current, single laser guide star adaptive optics system (LGS) with a multi-conjugate adaptive optics laser guide star system (MCAO). The MCAO system under development requires the implementation of 4 to 6 Laser Launch Telescopes (LLTs) nominally 1.5-m long by 475-mm diameter weighing approximately 150 kilograms. The LLT's mount to the telescope's center section and rotates with the telescope along its elevation angle. The LLT mount must provide the ability to project the laser guide star beams repeatedly into an 8 arc minute constellation at an elevation of ~ 90 km with an accuracy of ¼ arc minute and maintain position regardless of observing conditions. The design, engineering and analysis included the evaluation of all loads, internal stresses, angular deflections, pointing accuracy, repeatability and resolution while satisfying all geometrical constraints. I performed all 3-d modeling and finite element analysis (FEA) with Autodesk Inventor. FEA results were verified using accepted closed form equations. The design went through several iterations and refinements prior to meeting or exceeding system requirements.

Biography:
Logan Sato was born and raised in Hilo on the Big Island of Hawaii. He is a 2016 Waiakea High graduate, who now attends Oregon State University pursuing a degree in Mechanical Engineering. He hopes to return home a pursue a career in the islands. His hobbies include fishing, speardiving and simply going outdoors. He also enjoys photography and playing pool with his friends on the weekend.



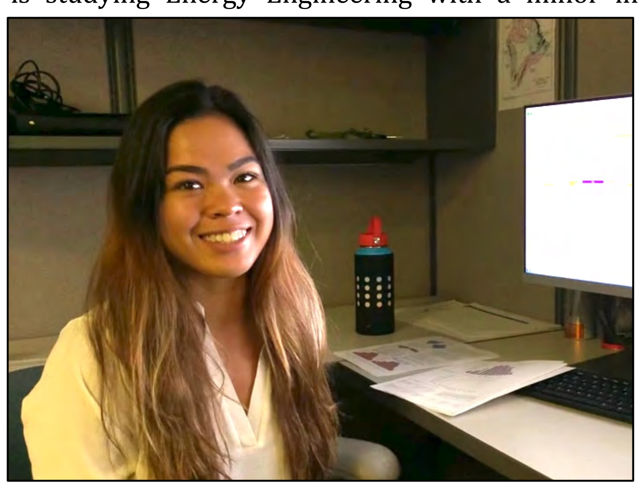
Brianna Brooke Shero
Pennsylvania State University

Site: Hawaii Electric Light Co. – Hilo, Hawaiʻi Island HI
Mentors: Robert Kaneshiro, Lisa Dangelmaier

Updating and Increasing Accuracy of a Visualization Tool for System Operations to Include Future Renewable Energy Power Plants and Battery Energy Storage Systems

With the upcoming transition to a 100% renewable energy portfolio, system operations at HELCO is in need of updating their Microsoft Excel based Forecast Visualization Tool. This tool utilizes historical load data, general data of the power plants (PP) on island, and anticipated distributed generated photovoltaics (DGPV) load shedding values (rated by Hawaii Island irradiance) to determine generation needed for the next 24 hours. It outputs a 24-hour graph that illustrates the load line, the megawatt (MW) generation of PP at determined times, and if the regulation ranges of generation fit the load line. In order to increase the relevancy of this tool, there are several updates that need to be made in the accuracy of the data and the overall ability of the tool. With a single input to forecast a load line given DGPV, there are often dramatic differences between expected and actual load lines. Time intervals in which PP can be turned on and off in Unit Control were limited, making it difficult to visual needed power generation/degeneration during transition periods. The tool also did not include vital current and future PP, the most important being two 30 MW PV farms with a 120 MWh battery energy storage system (BESS) attached to both. Now, instead of relying on averaged historical data and a single rating to determine a load line, current hourly forecasted data of DGPV from Hawaiian Electric's Solar and Wind Integrated Tool (SWIFT) can be inputted to create a load line specific to the upcoming day. I then expanded Unit Control to two-hour intervals from 5am-11pm and additional graphs focusing on vital transition phases assisted with regulation range visuals. The PV farms were more comprehensive to utilize, given irradiance data specific to their location had to be extrapolated from SWIFT. The tool then had to determine how attached BESS would charge during low load/high sun periods and discharge for high load/low sun periods as operators place limits to PV farm grid feeding. Users can then discharge BESS for peak periods instead of relying on non-renewable PP to make up for the shortage of generation. These revisions will allow system operators to properly forecast the day ahead and know at what times they can expect to limit or start generation from certain PP to maintain proper regulation ranges for the next 24 hours. It will also benefit system operation/planning engineers, providing them with a visualization of future problems and solutions to grid integration of renewable energy resources and BESS.

Biography:
Brianna grew up in Kona, Hawaii and is now a rising junior at The Pennsylvania State University. With the goal to be first line in the transition to renewable/green energy, she is studying Energy Engineering with a minor in Electrochemical Engineering. After her undergraduate career, she hopes to continue her graduate studies conducting research on new ways to harness energy and increasing efficiency in current energy production/storage. Her main interest consists of exploring how to utilize her studies in isolated areas/micro-grids to promote energy independence, design of power plants/fuel cells, and EV battery productions. She also wants to gain an audience to promote and share her sustainable STEM experiences with the hope it will influence next generations to explore careers in STEM and teach others about individual sustainable practices. Outside her studies, she always takes the opportunity to travel, scuba dive, snowboard, hike and practice fitness anyway she can.



Brandon Smith
San Diego State University

Site: Daniel K. Inouye Solar Telescope – Pukalani, Maui
Mentors: Brialyn Onodera, Chriselle Galapon

Plate Coil Verification Testing

The Daniel K. Inouye Solar Telescope will be operational during daytime hours introducing increased solar radiation to the enclosure. The temperature gradient between ambient air and the enclosure surface will cause convective airflow which disrupts telescope seeing. The Carousel Cooling system consists of plate coils for the DKIST enclosure which will help maintain the enclosure at ambient temperature and reduce seeing effects caused by surface temperature differences. A single plate coil was tested to ensure heat deposition requirements were satisfied based on the manufacturer's specifications. The test setup includes a test rig which allows the plate coil to be secured. Dynalene HC-20 is delivered to the plate coil using interconnected piping which circulates the Dynalene through a pump, chiller, and two flow control valves. The measurement equipment was verified before testing and includes thermal imaging, temperature sensors, ultrasonic flow meters, and pressure gauges. The test plate sample has been subject to previous thermal analysis by the manufacturer using fabricated environmental conditions to match those onsite. The calculation of heat dissipation for the sample will be compared to the results derived by the plate coil manufacturers to prove that they meet the necessary thermal functional requirements. Additional testing should be done to confirm the results obtained for the plate coil sample.

Biography:
Brandon grew up on the island of Maui and graduated from Seabury Hall in 2015. He attends San Diego State University and is pursuing a Bachelor's of Science in Mechanical Engineering. Brandon is interested in thermal energy and mechanical design. After undergraduate school Brandon will look towards furthering his education in graduate school. Brandon enjoys surfing or snowboarding in his free time.

Tré Soultz
University of Nevada, Reno

Site: Liquid Robotics: Hawaii Operations Branch - Kawaihae, Hawaiʻi Island HI
Mentors: Ryan Kopcso, Daniel Merritt

Ruggedized Charger Housing Design and Analysis

The Liquid Robotics Company is working towards a digital ocean where oceanographic communications and information can be readily available 24/7. The Liquid Robotics Wave Glider is an autonomous surface vessel designed to collect data in ways or locations previously too costly or challenging to operate in. While Wave Gliders are on shore or on a deployment vessel, their onboard batteries can be recharged utilizing an external charger and debug cable. The debug cable serves as a hardwire connection to the Wave Glider's network for data and communication. The Wave Glider's charger is currently not waterproof so wet environments can short the charger and pose safety issues to field personnel or the vehicle itself. The goal of this project is to design a charger housing that is submersible, drop resistant, transportation friendly, and maintains all of the functionality of the current charger and debug cable. Early in the design process, thermal overload was identified as the main roadblock in the housing design. After running thermal tests, it was discovered that the charger heats up excessively during use requiring a cooling mechanism. The prototype design of the housing involved using a commercial off-the-shelf waterproof case and retrofitting it with a heat sink and bulkhead connectors. From our available test results, we can see the charger will remain well within its operable thermal range. These results were gathered before and after the housing underwent drop and submersion tests. In the future, more controlled testing methods should be used to provide better test results. Furthermore, controlled methods of assembly should be utilized to produce a more robust design.

Biography:
Born and raised in Hilo, Tré Soultz is a Waiakea High School class of 2016 graduate. Tré is currently a junior attending the University of Nevada, Reno pursuing a B.S. in Mechanical Engineering along with a minor in Mathematics. He is an active member of the university's Hawaii club, Circle K, and works at the campus bookstore. After graduating, Tré plans on returning to the Big Island where he hopes to secure a job that works to preserve the place he calls home. During his limited free time, he likes playing games with friends, cooking at home, and enjoying the various outdoor activities Reno has to offer.

Elise Sueoka
University of Hawaiʻi at Mānoa

Site: Thirty Meter Telescope: WFOS - UC Santa Cruz,
University of California Observatories
Mentors: Kyle Westfall, Renate Kupke

Creating a Focal Plane to Detector Interpolator for TMT's WFOS

The Wide-Field Optical Spectrograph (WFOS) is a slit-mask spectrograph and one of two first-light instruments for the Thirty Meter Telescope (TMT). WFOS is currently in the conceptual design phase, and the optical design is being refined using Zemax software. Adjustments to the optical design are frequent and tested against performance requirements defined by the science that WFOS will do. To assess whether these requirements are met, a simulation package is also being developed primarily in Python. However, developing an accurate simulation solely in Python would be inefficient and a direct interface between Zemax and Python is nontrivial due to Zemax software's proprietary and complex attributes. Therefore, we are developing a WFOS-specific instrument simulator software tool in Python that minimizes dependency on Zemax and runs efficiently for calculations needed to design observations. The Zemax simulation yields focal plane-to-detector ray mapping files which I used to create an interpolator for the WFOS Python instrument simulator. The interpolator should predict where light rays from the focal plane will land on the detector accurate to 5 pixels or fewer whilst utilizing as little data as possible to minimize runtime. Working with WFOS collaborators in India who provided us with preliminary Zemax mapping files, I constructed interpolators with files of differing grid resolutions and compared the accuracy of points produced by these interpolators. The current version of the interpolator is accurate to the order of 5 pixels that takes in a 20×20×150 sized map file with a runtime of a few milliseconds for a single interpolation. As this is an essential part of the entire WFOS instrument simulator, when the entirety of the simulator is completed an astronomer will use it to efficiently plan observations with WFOS.

Biography:

Elise was born and raised in Honolulu, Hawaii and graduated from Kalani High School in 2016. She is currently pursuing a Bachelor of Science degree in Electrical Engineering with a minor in Astrophysics at the University of Hawaiʻi at Mānoa. In the future, she would like to do work related to the development and improvement of astronomy instrumentation. Elise is an active member of UHM's Society of Women Engineers section and volunteers at K-12 STEM outreach events. In her free time she enjoys drawing, playing the bass guitar, and getting milk tea with her friends.

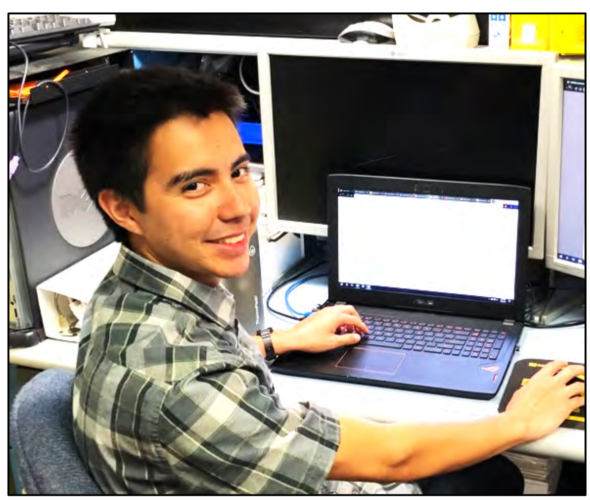
Abraham Sylvester
University of Hawaii at Manoa

Site: Subaru Telescope, NAOJ – Hilo, Hawaiʻi Island HI
Mentors: Lucio Ramos

Feasibility Study and Proposed Installation of Replacement UPS units for Subaru Telescope

Uninterruptible Power Supplies (UPS's) are an important part of keeping the Subaru telescope operational and prevents critical systems from failing or shutting down improperly. When there are power outages caused by storms or other unforeseen events, the UPS's ensure that critical systems remain powered to either shut down correctly or keep running until backup power is established. In 2018, two of the UPS's at the summit went down causing the site to have limited capabilities for over a month resulting in the loss of valuable research and observation time. The current UPS's at Subaru are old, outdated, and in need of replacement. To find suitable replacements research into the specifications and layout of the current UPS's were conducted along with factors such as environmental aspects and load capacity. Some key findings pertained to the lack of atmosphere and the sub-zero temperatures at the summit which cause the UPS's to derate and are major factors in determining capacity, runtime, and cooling. Subaru's load capacity was found to vary greatly depending on which instruments are used but has a max load of 130 kVA (kilo Volt Amps) per unit. Other factors considered and researched were the input and output requirements, unit efficiency, battery capacity or runtime, footprint, and load type. Research was also conducted into lithium battery technology and the newest UPS units on the market. Lithium batteries were found to be an infeasible option due to the low temperatures at the summit which can cause complications with their recharging. Newer UPS models also offer options such as battery monitoring systems, maintenance bypass, and remote communication. With the information collected, three best fit units from Eaton, Vertiv, and APC were evaluated to create a cost and benefit analysis. Assessment of the UPS site at the summit led to a proposal for the parallel installation of the new UPS units. The proposed installation will be to place the new UPS's in the room above the current UPS's to minimize downtime at the cost of modifying the floor. A second alternative would be to replace each UPS one at a time over two days making no modifications to the existing setup but requiring more time. The research done in this project will help in deciding the future replacement UPS units and provide a plan for their parallel installation.

Biography:
Abraham was born and raised in Hilo, Hawaii and graduated from Waiakea High School. He attended the University of Hawaii at Manoa and graduated in May 2019 with a bachelors degree in Electrical Engineering with a focus in systems and signal analysis. After graduating he plans to remain in Hawaii and pursue a career in research and development and to eventually start his own engineering business with his brother. In his free time he likes to go on hikes, go to the beach, play ukulele, and play video games.



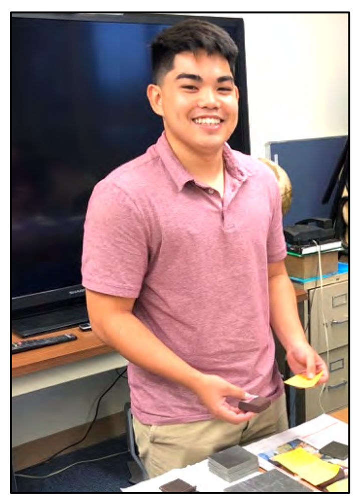
Joshua Tokunaga
Arizona State University

Site: PISCES – Hilo, Hawaiʻi Island HI
Mentors: Kyla Edison, Rodrigo Romo

Mechanical and Structural Properties of Sintered Hawaiian Basalt Tiles

In-situ resource utilization (ISRU) is the practice of using resources naturally found on planetary bodies in order to minimize the payload weight of a spacecraft launched from Earth. On the Moon and Mars, the resource available is basaltic regolith (loose unconsolidated rock material found on the surface), which could be used to create structures such as vertical launch and landing pads, foundations, and shelters. The Pacific International Space Center for Exploration Systems (PISCES) creates construction materials through a process known as sintering, where loose aggregate material is fired much like ceramic in a high temperature kiln. Due to Hawaii's chemical and mineralogical likeliness to the Moon and Mars, Hawaiian basalt aggregate is used as simulant feedstock for the production of tiles and pavers. In order to investigate the viability and characteristics of sintered materials, multiple tile samples were tested to check for sinterability and to understand their mechanical properties. These samples originated from different commercial quarries across the island of Hawaii and were fired under varying conditions (grain size, temperature, etc.). Lab tests such as hardness, porosity, and density were performed on all sintered basalt samples. Tiles that sintered well were tested for thermal conductivity, specific heat capacity, thermal expansion coefficient and thermal shock. These thermal properties will give insight into how sintered basalt behaves under the extreme temperatures of foreign environments and whether it will fare well as a launch/landing pad. Results show that tiles sintered at higher temperatures had increased hardness, density, and less pore absorbance. Higher sintering temperatures fuse grains together more efficiently which limits the amount of air space between them. These tiles also proved to be better heat conductors and have greater specific heat capacities. The data obtained from these various experiments were used to update and add to PISCES's research in understanding the physical and chemical behaviors of sintered basalt, and its place in the future of Lunar/Martian colonization.

Biography:
Joshua Tokunaga was born and raised on the island of Oahu. He graduated in 2016 from Saint Louis School where he played football and basketball. He currently attends Arizona State University and plans to graduate in 2020 with a BS in Earth and Space Exploration: Astrobiology and Biogeosciences and a minor in Sustainability. He is specifically interested in planetary science and hopes to pursue a career as a research scientist. In his free time, he enjoys watching and playing sports, hanging out with friends, and helping those in his fraternity, Phi Kappa Tau, with schoolwork, events, and meetings.



Leomana Turalde
University of Hawaiʻi at Mānoa

Site: Gemini North Observatory – Hilo, Hawaiʻi Island HI
Mentor: Matthew Taylor

SCABS Data Quality Assessment and Artificial Star Experiment

The Survey of Centaurus A's Baryonic Structures (SCABS) has observed the Giant elliptical Galaxy to find dwarf galaxies. This will aid the understanding of stellar populations and provide us with a legacy resource catalog for future astronomy use. The Dark Energy Camera mounted on the 4m Blanco telescope at Cerro Tololo Inter-American Observatory, Chile, was used in observations for this project. The images were processed through the science program called DEcam, a custom, Python-based reduction pipeline, and is responsible for finding the point sources of light. The images are taken and ran through a data quality assessment program. The program will use python tools to quantify the depth of the images and assess the data. The original image will be used to find source-free regions in the images where artificial stars can be inserted. We create a list of artificial point sources of light and add them to the real image. The source detection algorithm then re-finds these light sources and quantifies at what brightness cutoff 50% and 90% of the artificial sources can be recovered. This will help build a standard baseline for future researchers to understand the overall depth of the legacy catalogues.

Biography:
Leomana Turalde is a Hilo native. He was raised in Hawaiian emersion schools until his last year and graduated from Waiakea High School. He Joined the Marine Corps Infantry in 2005 and served in multiple combat tours with the Marine Force Reconnaissance Teams. In 2011 he left the military and started dancing for Chinky Mahoe and Kawailiʻulā, and since then has become a prominent dancer and composer. His hobbies are traveling, extreme sports, jiujitsu, fighting, poetry, reading, philosophy, sky diving and cliff jumping. This past semester he was a part of UHCC project Imua team that competed in the NASA Student launch Project and was the team rocket engineer and Safety officer.

Chase Urasaki
University of Hawai'i at Manoa

Site: Daniel K. Inouye Solar Telescope - Pukalani, Maui
Mentors: David Harrington, Andre Fehlmann

Creating an Extensive Spectral Database for the DKIST Flux Budget

The Daniel K. Inouye Solar Telescope (DKIST) currently is using the Simple Model for Atmospheric Radiative Transfer of Sunshine (SMARTS) to provide spectral information used in the flux budget. To be ready for the science use cases, the flux budget requires a more comprehensive assessment of the impact of atmospheric effects. This project will focus on creating a database of atmospheric transmission and spectral irradiance data that includes a number of atmospheric observing conditions. The current SMARTS - based flux budget is derived from a single nominal atmosphere with no dependency on variables such as airmass and columnated water vapor. To address this, the MODerate resolution TRANsmission (MODTRAN) program was used. This program simulates electromagnetic radiation through the atmosphere and was used to conduct a variable assessment of aerosol optical depth, water vapor content, and airmass on transmission and irradiance of sunlight. Using empirical data, I found that aerosol optical depth made no significant contribution, while assessing the impacts of water vapor content at the 10th, 50th, and 90th percentile for yearly values was sufficient for modeling atmospheric transmission. Airmass values were taken at increments of 5 degrees of solar elevation ranging from 5° to 90°. I created a database of transmission and irradiance spectra ranging from 0.200 microns to 30.0 microns with using different combinations of these observing variables in MODTRAN. To readily access this information, I wrote retrieval script to retrieve data from a specified set of spectral range and certain observing conditions. Additionally, this script can also interpolate data points that were not sampled and will convolve and sample the spectrum with a given instrumental profile. The band model for MODTRAN limits resolution of this database at spectral resolving power (R) of about 100,000 in the visible range of wavelengths, while existing measured databases, such as the NSO atlases, reach an R ~ 1,000,000. With this consideration and in future use cases, the database and retrieval tool can be used on any instrument performance calculator at DKIST, and can be used to help the current and next generation of instruments.

Biography:
Chase is a class of 2015 graduate from Aiea High School, and will be finishing his double major in Astrophysics and Math at the University of Hawai'i at Manoa in the fall of 2019. He hopes to go on to graduate school to pursue a graduate degree in Astrophysics and continue to do research. When he's not in class, he is actively involved in ASUH, the undergraduate student government at UH Manoa, or using his free time to build computers and looking for the best ramen spot on Oahu.

Makena Wagner
Smith College

Site: W.M Keck Observatory – Waimea, Hawai'i Island HI
Mentor: Truman Wold

Mirror Segment Floor Cart, Flip Fixture, and Balance Improvements

Each telescope of the W.M. Keck Observatory holds a primary mirror made up of 36 hexagonal mirror segments. These segments are continuously being exchanged with the newly recoated mirrors held in storage. The mirror segments are transported and stored on floor carts that hold the primary mirror segments on a flip fixture system that spins, flips, and holds the segments in multiple orientations. An unloaded flip fixture has an overwhelmingly strong moment of inertia that is currently held by a friction brake that often does not engage, putting the staff and equipment safety at risk. The responsibility of holding back the strong moment of inertia relies on three staff members who physically flip the flip fixture by hand. In addition, the flip fixture has an imbalance when hoisted by the spreader bar, which puts the primary mirror segment equipment at risk. Thirdly, the floor cart needs stabilizing when not in contact with earthquake holds, which physically bolt the floor cart to the floor, putting the primary mirror segment equipment and staff at risk. Keck seeks to improve the flip fixture, floor cart, and spreader bar system, in order to increase the safety of their staff and equipment. I have designed a worm gear assembly capable of holding and flipping the moment load of an unloaded flip fixture. The new gear assembly will allow the staff to easily operate the flip fixture without having to physically flip it themselves, by applying a force of just 2.5lbs to a wheel handle. Working with already established models of the spreader bar on SolidWorks, I was able to cross check my new designs, model interfaces, and moment calculations, for potential spreader bar counterweights. The new counterweights are adjustable and account for any asymmetrical imbalance within the flip fixture, ensuring that the primary mirror segment equipment is in alignment when hoisted and lowered. To improve the stabilization within the telescope domes, where there aren't any threaded anchor holes for earthquake holds, I applied compact, easy foot engagement, floor brakes which will be mounted on the floor cart. Throughout these projects I have gone to the summit to analyze the issues at hand and have developed a list of requirements with multiple employees who specialize in problem solving. The improvements I have made will allow Keck to safely handle the primary mirror segments without putting the lives of their employees and equipment at risk.

Biography:

Makena was born and raised in Hilo, Hawai'i and attended Kamehameha Schools Hawai'i. She now attends Smith College in Massachusetts where she is currently pursuing her bachelor's of science in Engineering with a minor in Architecture and Urbanism. As a student athlete, this is Makena's third year on the Pioneers Varsity Softball team. In her spare time Makena enjoys fishing and hanging out with friends. She hopes to return home after graduation and work as a local engineer. Last year, Makena also participated in Akamai, creating a test rig for linear encoders and interchangeable motor drives at Gemini Observatory North.

Stacey Yanagihara
University of Hawaii at Hilo

Site: Institute for Astronomy – Hilo, Hawaiʻi Island HI
Mentors: Paul Barnes, Christoph Baranec

Speeding Up Wavefront Sensor Backgrounds for Robo-AO

Robo-AO is a laser adaptive optics system on the UH 2.2 meter telescope on Maunakea. This system autonomously takes a background image in order to produce a calibrated wavefront sensor image. Currently, Robo-AO has a time delay with this process; therefore, it needs a faster switching system for taking the wavefront sensor backgrounds. By doing so, this will increase the efficiency of the observing system by an extra two hours on a four-night observation period. Robo-AO uses a pulsed laser that is triggered by the 10kHz master clock that outputs a transistor-transistor logic (TTL) signal. This signal is then sent to the signal delay generator that is responsible for sending on/off signals to the pockels cell of Robo-AO. After receiving a TTL signal, the delay generator waits 63 microseconds to send an on signal to the pockels cell and then waits an additional three microseconds to send an off signal. The generator is currently switched on and off by the A/C power supply; however, when it turns back on, there is a time lag of five to six seconds. My solution to this involves creating a C++ program for a USB (Universal Serial Bus) Solid State Relay that will interrupt the signal and suppress the on/off signals that are sent to the generator and to the pockels cell. This will allow Robo-AO's system to take faster background images and allow for more observations to be performed every night.

Biography:
Stacey Yanagihara was born and raised in Hilo, Hawaii. She is currently pursuing a Bachelor of Science Degree in Computer Science at the University of Hawaii at Hilo. Her main interest is in video game development and software engineering. If she is not working or studying, Stacey enjoys spending time outdoors or just hanging out with her family and friends.

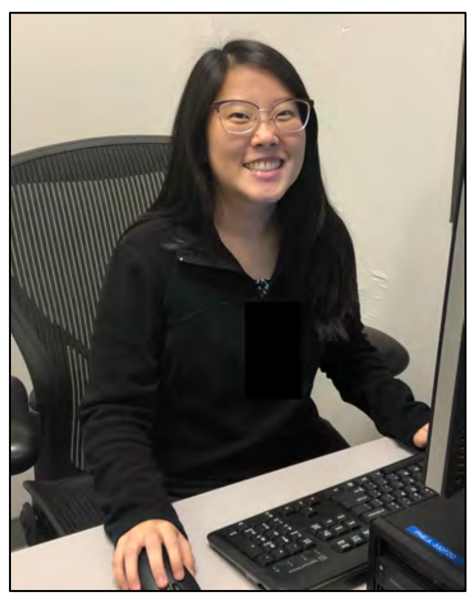
Sherie Yip
Honolulu Community College

Site: Maui High Performance Computing Center – Kihei, Maui
Mentors: Dr. Robert Trevino, Dr. Wesley Emeneker
Collaborator: David Zane

Detecting Network Anomalies with Deep Learning: Implementing BiGAN

Cyber defense is critical to the U.S. Department of Defense (DoD). DoD's ability to defend the nation relies on secure network communications. Therefore, the DoD actively searches for new tactics to identify anomalous network behavior that could pose a security threat to the network. Detecting anomalies is a difficult task for cybersecurity professionals, as network threats come in different shapes, sizes, and speeds. The Maui High Performance Computing Center (MHPCC), a DoD Supercomputing Resource Center, is researching and implementing cutting-edge deep learning network anomaly detectors. The anomaly detection systems being developed at MHPCC inspects for potentially threatening events and network activities. In this project, I developed and trained a deep learning model called a Bidirectional Generative Adversarial Network (BiGAN) to perform network security threat analysis. Built with Python and TensorFlow, BiGAN utilizes historical network data to learn to differentiate between anomalous and normal network traffic. I trained the model to generate and detect various anomalies. A goal of the project is to create a model that can learn any network communication principle or network protocol, making it a malleable BiGAN. This will help DoD cybersecurity professionals respond to network security threats with quick anomaly detection and by reducing manual network analysis.

Biography:
Sherie was born and raised on the island of Maui. She graduated from Maui High School, where she cultivated her love for information technology. Currently, she is pursuing a degree in Computer, Electronics, and Networking Technologies at Honolulu Community College. While attending, Sherie competed in the Collegiate Cyber Defense Competition (CCDC) and her team placed 4th for the West Region. Sherie hopes to continue her education in Information Security and Assurance at University of Hawaii–West Oahu. After graduation, she hopes to start a career in networking or cybersecurity. Apart from academics, she enjoys building computers, hiking, and playing basketball.



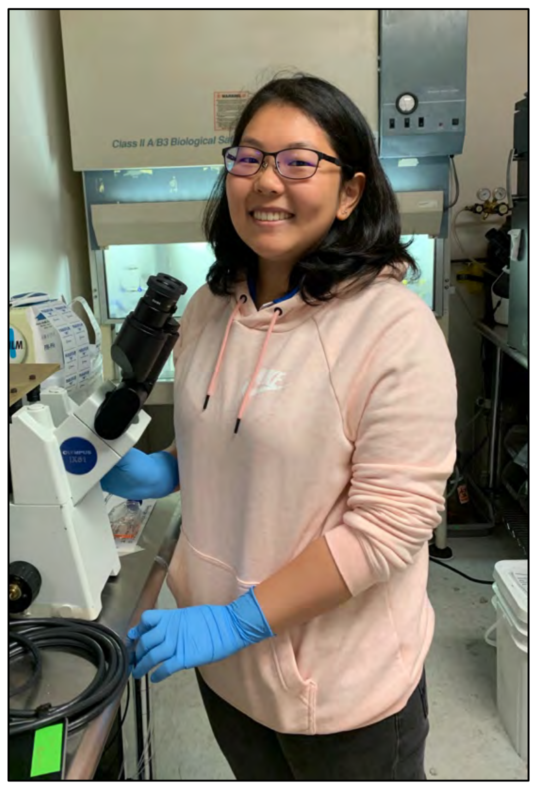
Dayna Yoshimura
University of Portland

Site: HNu Photonics – Kahului, Maui
Mentors: Devin Ridgley, Sylvia Loh, Brittany Willbrand

Phoenix: A Portable Incubator to Transport Live Cell Samples

State-of-the-art cell therapies are not available to individuals incapable of traveling to specific treatment centers, including warfighters and extremely ill patients. Cell therapy treatments require the use of sensitive cell lines, such as stem cells, that do not recover well from the cryopreservation process. SCORPIO-V has developed Phoenix, a compact, portable incubator to transport live cell culture samples to remote locations. Phoenix is required to be modular to ship via freight, thermally efficient to maintain cell viability, and power efficient to prolong battery life. In this study, the design and electronics of Phoenix were tested to observe proliferation of SH-SY5Y neuroblastoma cells and energy consumption over five days. Phoenix was validated to maintain cell culture for up to five days independently of a CO_2 incubator. Following the incubation periods, proliferation rates were collected to compare the cell densities of culture flasks in the Phoenix and the standard CO_2 incubator. It was determined that the cell proliferation rates in the Phoenix and standard CO_2 incubator did not have significant differences when cells were incubated for up to five days, suggesting the cell cultures may survive without a consistent CO_2 environment. One battery cycle lasted for 64 hours prior to power failure, which may be improved with the addition of insulation and power efficient components. Phoenix may be utilized by hospitals and researchers as long-distance transportation vehicle to deliver cell samples and extend accessibility of cell therapy to more patients.

Biography:
Dayna Yoshimura was born and raised on the island of Maui. After graduating from Maui High School in 2014, she attended the University of Portland where she graduated in May 2019 with a Bachelor of Science in Electrical Engineering. This fall, she will be continuing her education at the University of Portland in pursuit of a Masters of Biomedical Engineering degree. Dayna is involved with the Biomedical Engineering Society Chapter at the University and enjoys reading and playing video games in her free time.



Lee Danielle Young
University of Hawaiʻi at Mānoa

Site: Canada-France-Hawaii Telescope – Waimea, Hawaiʻi Island HI
Mentors: Gregory Barrick, Tom Benedict
Collaborator: Matthew Buchan

SPIRou Cooling System to Reduce Thermal Background

SPIRou is a high-precision spectrograph used by Canada-France-Hawaii Telescope on the summit of Maunakea. By working in the near-infrared, observers use SPIRou to search for planets in the galaxy while looking at nearby stars' motion and magnetic field. Due to warmer instrument and ambient temperatures, thermal background appearing in data collection is higher than desired. Consequently, SPIRou's capabilities to detect finer details are hindered. The goal of the project was to mitigate the thermal background by implementing cooling methods and designing insulation hardware to achieve reduced and stable temperatures, which are currently five times higher than expected. Specific components of the instrument identified as thermal background sources were targets for cooling by testing cold-glycol heat exchangers with optimized flow. Complementary insulation was provided by self-manufactured foam elements. This hardware, modeled in SolidWorks, was designed to accommodate the complex geometry of sensitive instrument parts in addition to considering features such as maintenance and sustainability. Digging further into where other potential solutions are needed, on-site experiments and Python calculations to predict the effects of applying additional cooling were performed. Results obtained from this work will improve the thermal background and understanding for future reductions to implement. The success of the project helps observers and SPIRou to discover Earth-like planets that may be habitable or hosts of water, and investigate the impact of magnetic fields on star & planet formation.

Biography:
Danielle was born and raised in Honolulu, Hawaiʻi and graduated from Kalani High School. She is currently studying Mechanical Engineering at the University of Hawaiʻi at Mānoa. She has growing interests in space from her projects with the Hawaii Space Flight Laboratory and previously looking at Curiosity's data from the planet Mars. Danielle is active in her university's Society of Women Engineers (SWE) section and had the opportunity to lead as president for the past 2018 - 2019 year. After graduating, she hopes to eventually return to Hawaiʻi to work and plans to continue her involvement in SWE. In her free time, she enjoys spending time with her pet lovebirds, dog & cat sitting, traveling, and volunteering in her community at local K-12 STEM and robotics events.

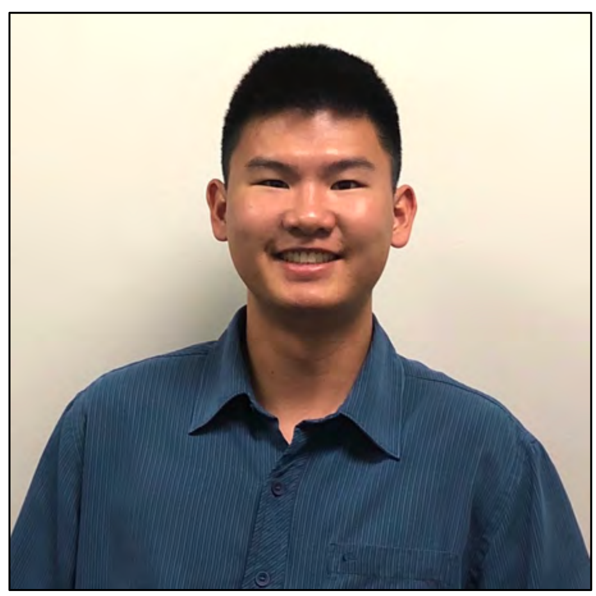
David Zane
Northwestern University

Site: Maui High Performance Computing Center – Kihei, Maui
Mentors: Dr. Wesley Emeneker, Dr. Robert Trevino
Collaborator: Sherie Yip

Deep Learning for Network Anomaly Detection: Building BiGAN

The United States Department of Defense (DoD) operates networks around the world which are constantly under attack. These attacks must be identified and defended against to ensure the safety of the United States and its people. Current cybersecurity software, specifically network anomaly detection, is able to detect known anomaly signatures but cannot learn to identify new attacks without human assistance. My project aims to develop an improved method of identifying potential attacks by using a deep learning Bidirectional Generative Adversarial Network (BiGAN). A BiGAN model consists of two competing neural networks called the generator and discriminator which attempt to outsmart each other. The generator attempts to create fake data similar to actual data while the discriminator learns to discern fake from real data. After training both components concurrently, the discriminator can then be used to effectively identify abnormal data. The KDD99 dataset, a popular network traffic dataset used for machine learning cybersecurity, was used to train and test the model. Results of BiGAN anomaly detection are forthcoming. This project serves as an exploration into how deep learning can be used for cybersecurity and will hopefully inform future development of the technology.

Biography:
David was born and raised in Honolulu, Hawaii. He is currently an undergraduate student at Northwestern University in Evanston, IL pursuing a BS in Computer Science. He enjoys programming algorithms and new interfaces. Outside of class David enjoys traveling, sports, spending time with family & friends, and eating lots of fresh broccoli.



Jonathan Zerez
Olin College of Engineering

Site: Thirty Meter Telescope International Observatory – Pasadena, CA
Mentors: Hugh Thompson, Peter Byrnes, Lianqi Wang

Vibration Measurement in Astronomical Observatories

Vibrations are one of the main limiting factors in the image resolution of high performance ground based telescopes with adaptive optics. Because vibrations have large implications for image quality and cannot always be eliminated, TMT is the one of the first telescopes to have a "vibration budget" integrated into the design phase of development. The vibration budget is a design tool that informs engineers about vibration specifications of different components required to meet the optical performance goals of the telescope. Physical vibration testing and analysis must be performed to validate many of the assumptions and models used in the creation of the budget. This project is focused around creating and refining software tools in order to streamline the data acquisition and analysis process for vibration tests. MATLAB was used to create programs that plot, analyze, and save data sent from National Instruments Data Acquisition hardware. These programs were validated by comparing their acceleration-over-force frequency response estimation of an object to the inverse mass of that object. Once validated, these programs were then used to collect and analyze vibration data from the Multi-Segment Integration and Testing structure (MSIT) using accelerometers and an impact hammer. Vibrational characteristics such as damping ratios and transfer functions were cataloged and compared to previously estimated values from Finite Element Models (FEM). This work confirmed the accuracy of existing models and will expedite future vibrational testing. The tools developed for this project provides valid insights only for relatively low frequencies where only rigid body modes are excited. As such, an extension to this project would be to develop methods for accurately characterizing the force generated by vibrations of an object outside of its rigid body modes.

Biography:
Originally from Honolulu, Hawaii, Jonathan Zerez is currently a sophomore studying Mechanical Engineering at the Olin College of Engineering. Outside of classwork, he is heavily involved in Olin's Formula SAE Electric project team where he specializes in systems modeling and analysis for vehicle development. He is also passionate about algorithmic music generation. In his free time, he likes to tinker around, play video games, and make music.

Akamai Internship Program

Akamai advances students into the Hawai‘i technical and scientific workforce. The program partners with industry, observatories, government, educational institutions, and community to meet workforce needs in astronomy, remote sensing, and other science and technology industries in Hawai‘i. Akamai is led by the Institute for Scientist & Engineer Educators (ISEE) at University of California, Santa Cruz.

The 2019 Akamai Internship Program placed 42 college students from Hawai‘i at the following organizations to complete a seven-week project:

- Air Force Research Laboratory (AFRL)
- Akimeka LLC
- Canada-France-Hawaii Telescope (CFHT)
- Cyanotech Corporation
- Daniel K. Inouye Solar Telescope (DKIST)
- Gemini Observatory
- Hawaii Electric Light Company (HELCO)
- HNu Photonics
- Liquid Robotics
- Maui High Performance Computing Center (MHPCC)
- Pacific International Space Center for Exploration Systems (PISCES)
- Pacific Defense Solutions, a Centauri company (PDS)
- Smithsonian Submillimeter Array (SMA)
- Academia Sinica Institute of Astronomy and Astrophysics (ASIAA)
- Subaru Telescope
- Thirty Meter Telescope International Observatory (TIO)
- UC Observatories / TMT WFOS
- University of Hawai‘i Institute for Astronomy, Hilo and Maui
- W.M. Keck Observatory

AWI currently receives funding and other support from:

- Thirty Meter Telescope International Observatory (TIO)
- Air Force Office of Scientific Research (FA95501510427)
- Hawaii Community Foundation Career Connected Learning Program.
- Daniel K. Inouye Solar Telescope
- University of Hawai‘i at Hilo
- Canada-France-Hawaii Telescope
- W.M. Keck Observatory

For more information please contact:

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http://akamaihawaii.org