Technical Report 2:

Internship Skills Inventory: Review of Akamai Internship Projects on Hawai‘i Island

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1. Overview of the Akamai Workforce Initiative

The Akamai Workforce Initiative (AWI) partners high-tech industry, astronomical observatories, cutting-edge research, and inventive education to meet needs in astronomy, remote sensing, and other technology industries in Hawai'i. AWI provides training in electro-optics for a diverse student population through an innovative, culturally-relevant curriculum, designed to meet workforce needs. At the heart of the AWI are two internship programs that use a model developed by the Center for Adaptive Optics to retain and advance students into science and technology careers. The Maui Internship Program places students at Maui sites, primarily high tech companies, for a seven-week research experience. On Hawai'i Island, the Akamai Internship uses the same model, but places students at astronomical observatories. Through a carefully designed set of programs and activities, the AWI advances *akamai* – smart, clever, expert – students into the technology workforce on Maui, and more broadly in Hawai'i.

The AWI is headquartered at the University of Hawai'i Institute for Astronomy (IfA) on Maui, and partners the IfA with the Center for Adaptive Optics (CfAO) at UC Santa Cruz, the University of Hawai'i – Maui Community College (MCC), and the Air Force Maui Optical and Supercomputing Site (AMOS). In addition to the Akamai Internship Programs, AWI also includes the development of a new electro-optics curriculum at MCC, the development of science/engineering education expertise through the Teaching and Curriculum Collaborative, and recruitment activities in Hawai'i's high schools. These components are interwoven and all serve the goals of: preparing local students for high-tech careers; increasing the capacity of and building partnerships among the local technical and educational communities; and increasing the participation of diverse populations in technology and technology education.

The AWI was launched in September 2007 and builds on years of partnership activities on Maui, including the Akamai Internship Program, curriculum development, and extensive partnering with industry. Past work was funded by the CfAO in partnership with MCC, the IfA, Maui Economic Development Board (MEDB), AMOS, and many industry partners. On Hawai'i Island, the AWI is built on a long-term partnership of the CfAO, W.M. Keck Observatory, Hawai'i Community College, University of Hawai'i – Hilo, and many Mauna Kea observatories.

2. Introduction to Technical Report

The Internship Skills Inventory was undertaken by the Akamai Workforce Initiative as part of a study to gain a better understanding of the workforce skills needed for the technical workforce on Maui and Hawaii Island. In this phase of the project, we reviewed five years of internship projects completed by Akamai interns in order to create an inventory of skills, understandings, and attitudes needed to be successful in a summer internship experience at an observatory or industry position. The inventory will be used to inform our longer-term project to define workforce needs, and ultimately the development of a new engineering technology program that will create a locally trained technical workforce in Hawaii.

The Akamai Internship Program places Hawaii college and university students (and *kama'aina* who attend school on the mainland) at observatory and industry positions for summer research experiences. Internships are available on Maui and Hawaii Island. Each island runs an internship program based on the model developed by the CfAO, but shaped to meet the unique needs and opportunities of the island. After acceptance into the program, a student is matched with an organization and a mentor, attends a one-week "short course" with fellow interns focusing on technology skills and content, and then completes a seven-week project under the guidance of the mentor and others at the organization. The Akamai program asks mentors to provide a project, or in some cases several smaller projects, that will be the student's own. Mentors are specifically asked to avoid projects which are primarily "shadowing" experiences, or skills-training that does not provide the intern with a project that they have ownership of, and can present in a technical symposium.

Student internships are often representative of the types of projects and work that will be assigned to entry-level technicians, and thus are a valuable source of information about workforce needs. The Akamai Internship Program has been in operation since 2004, and due to the extensive program records, has a wealth of information about student internship projects. Each student prepares an abstract, and oral presentation, and a poster presentation (see: http://cfao.ucolick.org/EO/internships/presentations.php). In this phase of our project, we reviewed program records, and conducted interviews with our 2008 project mentors to inventory the types of projects and skills Akamai interns engaged in from 2004-2008 in the Hawaii Island Akamai Internship Program. This report is substantially parallel to the previous AWI technical report on inventory skills for the Maui Akamai Internship Program.

3. Method:

In order to create an inventory of Akamai internship skills we utilized two sources of information from the Akamai program:

- Interviews with 2008 Akamai internship project hosts
- Past Akamai intern projects (2004-2007)

The authors wish to thank the academic institutions and observatories that contributed to this work. They have hosted Akamai interns in the past, and/or met with us for interviews.

This report reflects significant interpretation of the community's primary-source data by the authors. While we hope we have fairly represented the thoughts of those we've worked with, this report is the work of the AWI and should not be construed as the official position of any of the below-mentioned institutions.

3.1. Interviews with 2008 Akamai project hosts

Each year the Akamai program meets with prospective mentors to outline intern projects for the coming summer. The Akamai program staff meets with each mentor who will be working closely with an intern to learn about their ideas for projects, the skills and background needed to complete the project, as well as any additional information related to how to successfully match the intern and project. In January and February 2008 these meetings were conducted, and additionally, mentors were asked if they had new positions coming up and for information on skills that are important for their entry-level positions.

Internship hosts on Hawaii Island included:
W.M. Keck Observatory
Submillimeter Array (SMA) & AMiBA
Institute for Astronomy, Hilo
Gemini Observatory
Canada-France-Hawaii Telescope
UH Hilo
Subaru Telescope, NAOJ

3.2. Past Akamai Intern Projects

Past intern projects from 2004-07 were reviewed through project abstracts and Powerpoint presentations, and the tasks required to complete the project were identified. These projects took place at the same hosts as listed above.

3.3. Inventory of Intern Tasks

Skills and tasks identified from interviews and past intern projects were divided into hardware and software categories. Tasks included in the hardware and software category were further subdivided into more detailed task areas. The inventory is shown below. The order does not indicate any priority nor frequency in the tasks.

3.4. Engineering Process Skills:

Engineering process skills encompass the everyday practices and processes that engineers and technicians use to solve problems, design solutions, and keep things working. These are the types of skills that are transferable to new problems and technology, thus are tremendously important skills to develop if technicians are to continue to be productive as new technology and systems emerge. Engineering process skills came up frequently, and were phrased in a wide variety of ways, such as “calibrating,” or “designing” or “modeling.” We have observed that within the hardware and software categories, process skills are repeatedly brought up and merit additional study. AWI is currently studying engineering process skills and will publish a technical report in summer 2009 to report findings.

SOFTWARE
General
Search IDL libraries for program components (including Fourier filtering).
Employ equations from journal articles in programs
Create graphs of data
Modify LabVIEW programs
Document changes to LabVIEW programs suitable for first time LabVIEW users

Interfaces to Data
Port data from IDL to web interface.
Animate sequences of reduced data through a web interface
Create/manipulate GUI in IDL
Use IDL to create GUI for spectral analysis programs
Write scripts to create thumbnails of image data base
Optimize, add features and verify usability of a web based plot generator

Interfaces to Telescopes/Hardware
Use Python to create a GUI so view and control status of telescope sub-systems
Create an image database of Telescope sub-systems
Create Health Display in TCL/TK and EPICS
Create a user interface using TCL/TK for automation of instrument setup

Modeling
Build pointing model for antenna
Analyze pointing model in Math Cad
Model compressible gas flow in commercial software
Compare gauge measurements to model for gas flow pressures
Use computer model of pipe flow to predict required configuration
Explore ways of minimizing errors of an AO system using a computer model
Use computer model of deformable mirror to determine appropriate ways to prevent voltage surges.
Design an arbitrary wavefront generator

Analysis for Telescope/Hardware Improvement
Observe quasars as a basis for telescope calibration
Measure displacement using images taken from SMA antenna
Compare mirror vibration data before, after, and during vacuum regulator upgrade
Analyze how Atmospheric Differential Refraction affects position of star images using OSIRIS
Measure Spectra of laser die and use differences to make a diagnostic of the die.

Spin-off science
Analyze quasar data set to determine variability of quasars
Research Issues related to L and Ms band (infrared) spectroscopy
Take mid-IR spectra of comet before and after impact
Compare mid-IR spectra to identify different compositions
flat field and bias subtract an image, and correct for hot pixels

HARDWARE

Sensing and Monitoring

Determine telescope flexure using inclinometers
Test and calibrate inclinometers in lab and insitu
Monitor vibrations on mirror in two telescopes
Measure strain gauge resistances using a Wheatstone Bridge
Set up, mount, and test strain gauges to measure effects of counterweight system on telescope pointing
Use dual beam laser to align telescope mirrors
Design and install pre-alignment camera to view laser for alignment of mirrors
Design, fabricate, test, and install a system to remotely monitor and control helium compressors
Use a camera to measure the change in laser light propagation
Use laser and CCD to verify alignment of mirror segments
Build and install harness for temperature sensors
Create program in LabVIEW to read temperature sensors
Test laser system as a method of measuring seeing in observatory dome.
Test Laser system's ability to measure mean cross wind speed.

Maintenance

Check Radios with analyzer for signal, strength, reception, and tone key
Send faulty radios to vendor for repair
Maintenance of lubrication, friction, and wear systems at KECK

Design and Fabrication

Identify cameras suitable for extreme lighting and environmental conditions
Design a camera layout to observe areas of interest surrounding a building
Mount cameras, IP converter and power supplies in weather enclosure
Design optics train entrance diaphragm, including material selection, in Autodesk Inventor
Identify components of AO system from manuals and part codes
Order components of AO system from a list
Identify power, ventilation, mounting etc. for components of AO system
Measure Sound using oscilloscope
Cancel a sound using the inverse of the sound.
Implement an array of controller lab system for electronic testing and software design.
Fabricate electronics system
Design and fabricate a fan and body for controller system
Design and fabricate test boxes
Program a Field Programmable Gate Array using VHDL
Use Quartus II program to simulate, test and code a Field Programmable Gate Array
Create a portable test unit for summit operations
Propose a standard connector for test equipment
construct segmented mirror align it and test its functionality
Build structure, including foundation, for segmented mirror
Construct a segmented mirror detector system and obtain observations
Construct housing for detectors (construction work)