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Spring/Summer•2003
At the Crossroads of the Pacific

High Tech Maui

Maui-based Oceanit Opens Hawaii's Only Optical Design and Fabrication Center

Mike Palermiti prepares MOSAIC-Oceanit designed KStar for "First Light."

From many vantage points on Maui, you can look skyward and see the world-class optical systems and observatories that dot the 10,023 foot summit of Haleakala, one of the top five locations on the planet for night sky viewing. From Kihei, Maui you can also see the future of optics in Hawaii at Oceanit's Maui Optical Systems and Imaging Center (MOSAIC). Located at the Maui Research & Technology Center (MRTC), MOSAIC is Hawaii's only custom optics and prototyping facility and is dedicated to supporting the emerging optics and laser industry in Hawaii.

The mission of MOSAIC is to support the development of state-of-the-art laser and optical components and instruments in Hawaii by delivering design, fabrication, assembly, and testing services. The MOSAIC team can fabricate optics up to 16 inches in diameter and can produce products such as lenses, mirrors, and windows, including aspheres, from a variety of materials.

Leading the MOSAIC team is Dan O'Connell, senior optical engineer with Oceanit's Advanced Space Imaging Group at MRTC. Having spent many years sourcing optics from the mainland, O'Connell has experienced the challenges of building custom optics and instruments from Hawaii. One of those challenges is balancing the need to "tweak" an optical piece with the inconvenience of coordinating with a facility thousands of miles away and in a different time zone. With the opening of MOSAIC, Hawaii's optics and laser community will have the convenience of rapid optics prototyping right in their backyard.

New low-cost high-contrast NOAA-funded LIDAR designed and to be built at MOSAIC.

Before opening MOSAIC, Oceanit teamed with Joe Appels of the Tucson Optical Research Corporation (TORC). Already successful but interested in doing something new, Appels will bring his 50 plus years of optical fabrication experience, as well as members of his team, to Maui for the next year to support the startup of MOSAIC. "Our relationship with Appels and TORC is an incredible opportunity to transfer the knowledge of one of the most successful optical fabrication facilities in the country to Maui," says O'Connell.

Mirrors are just some of the growing capabilities at MOSAIC.

O'Connell believes optics and lasers will play a major role in Hawaii's economically diversified future. From advanced space imaging systems, to high energy laser systems, to the new University of Hawaii medical school, Oceanit's vision is to build a world-class design and fabrication center that will become a cornerstone for the infrastructure needed to support a new industry. Equally important, MOSAIC is teaming with Maui Community College and the Center for Adaptive Optics at the University of California, Santa Cruz to offer courses on Maui that will produce a highly skilled, well-paid labor force.

The MOSAIC team is already hard at work having secured several fabrication and design projects from customers on Maui and Oahu. Of course, it helps to have the highest concentrations of world-class observatories and the largest telescopes in the world in your backyard. In February 2003, the MOSAIC team visited prospective customers on Maui, the Big Island and Oahu, to learn about their optical requirements and to let them know that the convenience of designing and fabricating custom optics now resides in their neighborhood.

MOSAIC services all of Hawaii from its new facility in Kihei, Maui. MOSAIC chose MRTC because of the efforts of Jeanne Skog, President & CEO, and Steve Perkins, MRTC Program Manager, at the Maui Economic Development Board. O'Connell comments "Jeanne and Steve went the extra mile and developed a package that convinced the MOSAIC team that MRTC was the best place to setup shop." The MOSAIC team looked at several facilities around Kihei and on Oahu, but chose MRTC because of its high tech amenities, including close proximity to the Oceanit Maui office, and potential synergies with other high tech tenants.

BYTES

ILoea Corporation transmitted HDTV pictures at 1.45 gigabits per second – about 1,000 times the data rate of many home broadband connections – in support of ABC's broadcast of the Super Bowl. The live, high-resolution shots of scenic beauty near the stadium were woven into the broadcast in real-time.

2 The 4th annual AMOS Technical Conference will be held at the Wailea Marriott Outrigger from September 8-13, 2003. The conference series aims to provide optical, space surveillance, and computing professionals a cutting-edge forum to exchange and publish their work and ideas. It is intended for scientists, engineers, and technical managers from academia, industry, government, and military programs. Over 130 authors submitted abstracts describing new research, innovations, and developments in the following categories: Space Situational Awareness; Laser Propagation and Laser Radar; Imaging Theory; Algorithms; and Performance Prediction, Non-Resolved Object Characterization; Astronomy; Atmospherics; Small or Autonomous Telescope Systems; Adaptive optics; Orbital debris; Satellite Modeling; Computational Object Identification; High Performance Computing Applications in Astronomy; Other High Performance Computing Applications.

3 The Maui Economic Development Board Inc. (MEDB) received a $2 Million ceremonial check on May 15 representing the $2 Million grant awarded to MEDB by the Economic Development Administration to build new facilities for business incubation at the Maui Research and Technology Park. Dr. David Sampson, Assistant Secretary for Economic Development of the United States Department of Commerce presented the check to MEDB's President and CEO, Jeanne Skog and the Chairman of MEDB's Board, Allen Hunter.

4 The Women in Technology Program of MEDB, Inc. and the Center for Adaptive Optics (CfAO) welcomed the Maui Summer Akamai Internship Program, an NSF Science and Technology Center, on May 27. The eight-week program placed 11 students from Maui Community College with six technology companies on Maui and Hawaii Island. This is the first year the internship program is taking place on Maui. The program kicked off with a High Tech Maui Industry Education Exchange where various Maui tech businesses had the opportunity to meet graduate students and postdoctoral researchers currently working in the disciplines of astronomy, physics, vision science, and optical and electrical engineering.

Did you know?

To preserve the safety of on-orbit assets, the GEODSS telescope atop Mount Haleakala tracks almost 10,000 known assets as well as debris in Earth's orbit traveling at 17,000 mph.

Pacific Disaster Center's Automated Tsunami Aids Hawaii's 24/7 Emergency Operations

In the emergency management business, minimizing response time saves lives. Hawaii emergency responders worry about many scenarios, including the impact of tsunamis on the concentrated coastal infrastructure, population and beachgoers. From the time a tsunami develops to the time it reaches Hawaii's shores ranges from a few minutes to more than twelve hours, depending on whether it is an offshore landslide or an earthquake across the Pacific.

Maui's Pacific Disaster Center (PDC) has developed and deployed an Automated Tsunami Alert System that reliably provides Hawaii's emergency officials with critical tsunami travel-time information for tsunamis that may be generated when earthquakes of magnitude 7.5 or greater occur. The system improves emergency officials' awareness of a potential tsunami in three ways, by: automatically delivering the official Pacific Tsunami Warning Center tsunami bulletins via pager and cell phone to emergency managers; automatically posting the official tsunami bulletins to PDC's operational-oriented web site; and posting tsunami travel times to the Internet to Hawaii using a PDC modeling capability (figure 1).

From an emergency management perspective, PDC's Automated Tsunami Alert System provides rapid and uniform notification of tsunami advisory, watch, warning, and cancellation bulletins to more than 30 Hawaii State Civil Defense personnel and county emergency managers on a 24/7 basis anywhere within pager or cell phone range. This facilitates rapid emergency management decisions and actions for response purposes.

Tsunamis are a concern because more people have died from tsunamis in Hawaii than from hurricanes. Following any tsunami alert from PDC's Automated Tsunami Alert System, first responders communicate with Hawaii State tsunami science advisors and other responders, and can go to PDC's web site to view automatic model runs estimating tsunami travel times to Hawaii (figures 2 and 3).

PDC's Automated Tsunami Alert System has five subsystem modules, including:

1. **Data Capture and Processing Module:** The earthquake source data are received via electronic mail on a dedicated private communication network between the Pacific Tsunami Warning Center, Honolulu and PDC. Data are then automatically processed to read earthquake epicenter, location, and magnitude. In case of a potential tsunami situation (i.e., earthquake magnitude greater than 7.5), the event information is analyzed and forwarded to other subsystems for automatic notifications and an automatic travel-time model run.
2. **Notification Module:** People are notified using electronic mail, pager, and cell phone. PDC uses a standard email package running Simple Mail Transport Protocol (SMTP) to send alerts via emails, and a paging package that uses a modem to transmit a message to the recipient's paging service using Telelocator Alphanumeric Protocol (TAP). The alert system also sends text messages to text-capable cellular phones and pagers.

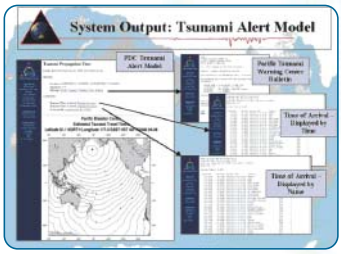


Figure 1. PDC's Automated Tsunami Alert System requires tsunami bulletin information input from the Pacific Tsunami Warning Center and produces automated tsunami notification alerts to emergency managers' cell phones, pagers, and email as well as outputs a model run to PDC's web site displaying estimated tsunami travel times (in hours) across the Pacific Ocean for emergency management purposes.

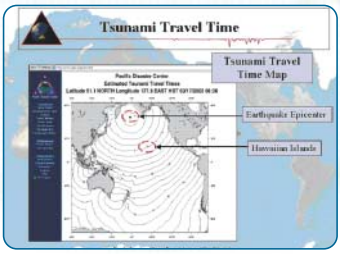
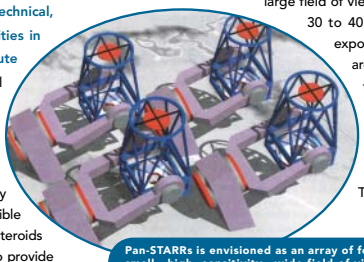


Figure 2. Tsunami Travel Time Model Result for recent March 17, 2003 Alaskan Rat Island earthquake, magnitude 6.9. Contour interval = 1 hour.

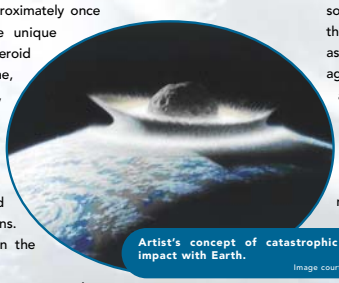
Pan-STARRS to Search for "Killer Asteroids"

Maui High Performance Computing Center's (MHPCC) University of Hawaii-led contractor team has been awarded a contract with the Air Force Research Laboratory (AFRL) to support the Panoramic Survey Telescopes and Rapid Response System (Pan-STARRS) program. MHPCC will provide technical, personnel, and computational resources for the Pan-STARRS program activities in support of an AFRL Grant awarded to the University of Hawaii's (UH) Institute for Astronomy (IfA). MHPCC is providing engineering and computational support services focusing on data processing architecture studies, algorithm development, system design, and computational and optical research.

Pan-STARRS is a new-start program that fuses astronomy, information technology, data processing, and data management. The system is being developed primarily to detect Near-Earth Objects (NEO) and Potentially Hazardous Asteroids (PHA) passing through the Earth's orbit at reasonably accessible solar elongations. A major goal of the project is to identify, long before impact, asteroids that might collide with Earth. Along with planetary defense, Pan-STARRS will also provide advanced research into deep space astrometry and photometry. The new Pan-STARRS telescope system is currently conceived of as an array of four small telescopes. Planned to become operational in 2007, Pan-STARRS will be more powerful for survey work than all existing telescopes combined. Each of the newly deployed telescopes will include a dedicated very wide field of view array of four telescopes with extremely large Charge Coupled Device cameras with one billion pixels each that are capable of taking images of space approximately every 30-60 seconds. It is currently estimated that Pan-STARRS will be able to survey the visible sky approximately once per week. The system will provide unique time-resolution capability enabling asteroid detection and detection of supernovae, gamma ray busts optical counterparts, other transient objects, and perhaps as yet unknown phenomena. The system will also generate a deep digital atlas of 70% of the sky, detecting nearly all dangerous objects and ultra-deep images of selected regions. This multi-year project is presently in the Concept Design phase.



Pan-STARRs is envisioned as an array of four small, high sensitivity, wide-field-of-view telescopes.



Artist's concept of catastrophic asteroid impact with Earth. Image courtesy of NASA.

Specifically, MHPCC's role on the program is to design and develop the data processing system and data storage systems. This work is initially focusing on system data processing pipeline functional requirements, design and architecture studies, algorithm review and development, software analysis and prototyping, end-to-end system modeling, data processing system development, data storage design, and optical research support.

While the telescopes are relatively small, their advanced technology will enable a very large field of view, allowing them to image an area about 30 to 40 times that of the full moon in a single exposure. The system will rapidly survey large areas of the sky, making it uniquely powerful for detecting transient objects such as supernovae, and for detecting moving objects, such as asteroids and comets.

Once operational, Pan-STARRS will generate huge quantities of data. To process data, the IfA astronomers have teamed up with the Maui High Performance Computer Center (MHPCC). It is planned that the huge database generated by Pan-STARRS will be made available over the Internet so that others may use it for research and education.

The data from Pan-STARRS will be used to address many scientific questions, ranging from the origin of the solar system to the properties of the Universe on the largest conceivable scales. The major goal of the project is to inventory potentially dangerous asteroids.

While most asteroids reside in the main asteroid belt lying between Mars and Jupiter, some, known as Near-Earth Objects (NEOs), have orbits that pass inside that of Earth, and therefore present a collision hazard. It is now widely recognized that a collision with a large asteroid was responsible for the mass extinction of the dinosaurs on Earth 65 million years ago, and that more frequent collisions with smaller asteroids present a real hazard. Fatal asteroid collisions are rare, but when they happen they can be very destructive. In fact, experts have determined that, averaged over time, the risk of dying from an asteroid strike is approximately that of dying in a plane crash. A number of recent widely publicized close encounters with asteroids have highlighted the risk.

Congress has charged NASA with supporting searches for large asteroids that might collide with Earth. These surveys determine the orbits of the asteroids that they discover, and then project them forward to see if they will impact Earth. Current survey telescopes have detected roughly half of the known objects larger than a mile in diameter; impacts associated with this magnitude would cause global-scale catastrophes. Pan-STARRS is being developed to more fully complete existing survey capability to extend and broaden the search to include much smaller objects.

Alert System

3. **Database Module:** PDC maintains and manages a contact database of user accounts, including user name, cell phone number, pager phone, email address, and carrier's Short Message Service (SMS) gateway computer modem number.

4. **HTTP Server Module:** This Internet portal displays tsunami bulletins, warnings, watches, and travel time maps in hypertext format. The module provides a front-end interface for administering the user database and a simple web-to-pager program for sending critical alerts. Information on recent tsunami events of interest to researchers is also available.

5. **Tsunami Travel Time Model Module:** This module is automatically triggered by tsunami bulletins to generate a map depicting epicenter of the earthquake and to model graphical representation of travel times away from the source location if a tsunami has been generated.

A tsunami alert generated from a Papua New Guinea magnitude 7.7 earthquake on Sunday, September 8, 2002 is a good example of the benefit of PDC's Automated Tsunami Alert System to emergency managers. Although no tsunami reached Hawaii, behind the scenes emergency officials managed information from the Automated Tsunami Alert System. On the morning of the quake, some emergency managers in Hawaii were notified of the tsunami potential from the distant earthquake within seconds of the tsunami bulletin being issued by the Pacific Tsunami Warning Center, Honolulu. Upon receiving the automatic alert, emergency officials began monitoring the situation and were prepared for further response and actions, if required.

Figure 3. Enlarged graphic from figure 2. Model estimates a potential tsunami travel time of five hours from Rat Island earthquake to Hawaii and three-to-five hours to traverse Japan.

PDC developed and deployed the Automated Tsunami Alert System in 1999 at the request of Hawaii State Civil Defense and the four county emergency services offices. Today, within the State, the alert system also broadcasts hurricane, weather, and earthquake bulletins from federal warning centers to emergency staff pagers or cell phones operational in Hawaii. The alert system also provides a foundation for broadcasting additional hazard bulletins in the future, such as flash floods and volcano alerts. PDC is studying ways to enhance this automated alert capability to assist international entities interested in similar technology applications.

Jim Buika, PDC's Director of Customer Applications Support and Training explains, "The Pacific Disaster Center's mission is to provide applied information, research and analysis support for the development of more effective policies, institutions, programs and information products for the disaster management and humanitarian assistance communities of the AsiaPacific region. The PDC is a public-private partnership sponsored by the PDC Program Office (ASD/NII). Since 2002, the East-West Center has been the managing partner of the PDC."

NASA Engineers Visit Maui Schools

John Del Frate shows Kihei Elementary students the amazing wingspan of Helios.

Jim Stewart, Deputy for Aeronautics Projects of NASA's Dryden Flight Research Center, visited Maui along with a group of his colleagues in late April. The visiting engineers were part of the Environmental Research Aircraft Sensor Technology (ERAST) team meeting in Kaanapali. NASA encourages its staff to visit local schools when they are on the road, because according to Stewart, one its goals is to "raise up the next generation of engineers." But it does not seem like a hard sell to get these guys to talk about the work they do; they were all enthusiastic about their projects as they shared with students at nine schools on Maui who were treated to visits by different members of the team. At Baldwin High School, students learned from Stewart that the ERAST project worked with the United States Unmanned Aerial Vehicles (UAV) program developing support for NASA's environmental science mission using high altitude long endurance UAVs. He explained to the students that ERAST has many planes, with speeds ranging from 20 MPH to Mach 7 this year and going up to Mach 10 in the near future, each built with a different objective. Solar powered craft have the advantage of storing energy during the day to fly at night, eliminating the need to refuel on long distance flights. Stewart also told the intrigued students that unmanned craft can go places manned planes cannot, like over erupting volcanoes, into hurricanes, and up to 65,000 feet to measure the clouds and ozone. Altair is one example of this type of craft that eliminates risk to pilots flying in extreme conditions. Another of ERAST's UAVs, Helios, flew from Kauai in the Summer of 2001, setting an altitude record of 96,863 feet.

Children at Kihei Elementary were excited as they were treated to a video that showed the Helios flight. John Del Frate, solar aircraft project manager at NASA Dryden Flight Research Center, also brought a scale model of Helios to show the children, demonstrating the proportions of the dramatic wing span, measuring 247 feet on the real plane. Del Frate then encouraged the students to ask questions, many of which were outstanding questions despite the young age of the students. It looks like some of them definitely have the potential to grow up to be the next generation of NASA engineers.

DATA POINT

Maui Researchers "In The Know" with New High Level Sci-Tech Database Access

Research engineers Chris Sabol, Craig McLaughlin and K. Kim Luu at the Air Force Research Laboratory (AFRL DET 15-Maui), are realizing the benefits of having electronic access to high-level sci-tech databases provided through the Hawaii Business Research Library's (HBRL) suite of desktop resources.

Ruth Corn, HBRL Library Director says, "Desktop access is critical to researchers who need to be able to tap into important sci-tech databases for juried articles to see what others are doing in similar situations." She was able to assist the engineers by using multiple online services and in this case, narrowing the search to Science Direct (a product of Elsevier Science) that contained the needed article in full-text digital format in the journal of Aerospace Science & Technology.

Sabol and his team wrote a conference report on formation flying of space satellites. Cluster orbits are defined as the relative trajectories of objects traveling through space in close proximity to each other. Sabol commented, "The article was needed as a reference for our report. Relative equations of motion may help us to keep track of the formation as one unit instead of a group of individual satellites. It is good to see what others are doing in similar situations."

Are you interested in the incubation/phase-in program at Maui Research & Technology Center, a project of the State's High Technology Development Corporation (HTDC)? Contact Steve Perkins, Program Manager, at steve@mrtc.org or (808) 875-2432.

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Maui High Performance Computing Center Increases Computational Power

Our nation's defense depends on technological superiority to maintain warfighting supremacy. Continued research, development, test, and evaluation (RDT&E) advancements in science and technology enable that supremacy. In 1993, the Maui High Performance Computing Center (MHPCC) pioneered supercomputing for the Department of Defense (DoD), with the inaugural IBM SP (Scalable-Parallel) High Performance Computing (HPC) system. From the first production implementation of IBM SP technology to the deployment of HPC systems implementing commodity processor complexes and open operating systems, MHPCC has been a leader in deploying advanced computing technologies supporting national defense.

As an Allocated Distributed Center of the Department of Defense High Performance Computing Modernization Program (HPCMP), MHPCC provides HPC and related services to the national research community. Extending its leadership in large-scale HPC systems that deploy the latest large shared memory architectures, MHPCC recently announced its acquisition of a $ 4+ M upgrade to its suite of computational platforms.

This cutting edge upgrade, which will be added to a current MHPCC system, operating under the name *Tempest*, consists of 10 nodes of IBM pSeries 690 technology. Each node houses 32 Power4 Central Processing Units (CPUs), for a total of 320 processors. The nodes are linked using IBM's proprietary Colony switch technology, allowing the separate CPUs to compute as a single system. Each CPU is rated at a clock speed of 1.3 GHz, providing an aggregate theoretical peak computational power of 1.66 TeraFLOPS (trillions of floating point operations per second). As testimony to both the MHPCC staff expertise and usability of the new system, system integration was completed in a record 30 days.

"High performance computing is a key enabling technology in advancing the United States' technological dominance in the 21st century. MHPCC will continue to extend its leadership in scalable computing technologies to meet our nation's ever increasing computational challenges."

— Eugene Bal, University of Hawaii Executive Director

Capt. Dale White, AFRL/MHPCC Program Manager, stated, "This new addition to our computational resources will go far in re-defining MHPCC as a vital contributor to DoD and government research and development. Combined with our highly advanced optical assets, this upgrade will serve as yet another step forward in cementing the Air Force Maui Optical & Supercomputing Site (AMOS) as one of the premiere research sites in the DoD."

Massively parallel supercomputers are uniquely suited for solving problems that lend themselves to "parallelization" (i.e., problems that are easily divided into many small, unique, and independently solvable calculations). MHPCC's new *Tempest* system augmentation will execute a broad array of applications including modeling and simulation, natural phenomena modeling such as weather forecasting, computational fluid dynamics, image processing, and computational chemistry.

[Left to right] Eugene Bal (MHPCC/UH Executive Director), Lt. Col. Jeff McCann (AFRL Commander, Detachment 15) and Capt. Dale White (AFRL/MHPCC Program Manager) perform ribbon cutting ceremonies on a model representative of their new IBM Power4 technology.

MHPCC is an Air Force Research Laboratory Center managed by the University of Hawaii. MHPCC's HPC complement numbers in excess of 2,000 processors, including the largest Linux cluster in the DoD inventory. The combined theoretical peak computational power of MHPCC's supercomputing configuration is 3.6 TeraFLOPS.

A ribbon cutting ceremony for the IBM Power4 upgrade was held on March 14, 2003 at MHPCC. Representatives from the Air Force Research Laboratory, state and local government, and Hawaii's high technology community attended the ceremony.

Eugene Bal, University of Hawaii Executive Director, commented, "High performance computing is a key enabling technology in advancing the United States' technological dominance in the 21st century. MHPCC will continue to extend its leadership in scalable computing technologies to meet our nation's ever increasing computational challenges."