

Outreach & Education



Keaukaha Robotics Program Inspires Youth

Left: Keaukaha Robotics Club members explain how their robot works to a young student. Right: (Foreground) Robotics Club members and (background, L-R) PISCES Director Rodrigo Romo with club mentors Joel Paye and Tayeh Madjeska.

If there's one thing that grabs the attention of kids these days, it's robots. Case in point—last month members of the Keaukaha robotics club demonstrated three of their VexIQ robots to youngsters, inspiring a steady crowd of visitors during Keaukaha Elementary School's 'ohana night on April 24. Their bots—which the club members built and programmed themselves with help from mentors—were a hit. Visitors learned how the competition-ready robots work, and how to drive them using a handheld remote.

The Keaukaha robotics club was first launched last November through a collaboration between PISCES, University of Hawaii at Hilo and RISE (Revealing Individual Strength for Excellence)—an extracurricular program designed for underserved Native Hawaiian children. The kids took to it with surprising enthusiasm. An initial team of half-a-dozen elementary students, mentored by Joel Paye of UH Hilo and Tayeh Madjeska of Hawaii Community College (both Hilo High School alumni), built and programmed their robots at surprising speed. In fact, they were nearly ready for competition within months—a goal that wasn't planned for another year.

"So far, this program has been a huge success," said PISCES Director Rodrigo Romo. "We expect this to be a long-term program to give Keaukaha youth new educational opportunities."

Both the kids' mentors and parents have commented that the students love the program and look forward to returning in August. The program is currently on summer break and will resume with plans to compete in the VexIQ league next year.

Message from the Program Director



Rodrigo Romo

Aloha Kakou,

As the legislative session comes to an end, I am feeling grateful for the strong support we received this year. Members of the House and Senate helped us secure enough funding to continue programs and projects in Applied Research, Workforce Development and Economic Development. My sincere appreciation goes to Representatives Mark Nakashima and Cindy Evans, as well as Senator Glenn Wakai for their support of PISCES during this session, as well as Director of DBEDT, Luis Salaveria.

We spent much of April writing, preparing and submitting three research grant proposals . . .

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Outreach & Education



Hōkūle'a Celebration Joins Culture and Science

Above (L-R): PISCES Geologist Kyla Defore, PISCES Director Rodrigo Romo, Gemini Outreach Interns Jasmin Silva and Hannah Blomgren. Below: (1) Visitors photograph the Hōkūle'a at Wailoa Pier. (2) Tours aboard the canoe drew a steady line of visitors all day. (3) A floor map demonstrates Hōkūle'a's voyage across the globe. (4) PISCES and Gemini staff talk-story with visitors about space science.

Staff from PISCES, Gemini Observatory, Subaru Telescope and TMT teamed up to talk-story about astronomy and aerospace with the community at the Hōkūle'a voyaging canoe's homecoming celebration held in Hilo on April 21.

Organized by 'Imiloa Astronomy Center, the event drew hundreds of visitors and featured hands-on educational activities, live music, robotic demonstrations and an on-board tour of the Hōkūle'a. Crewmembers of the double-hulled canoe just completed a historic three-year journey around the world using the same celestial navigation techniques practiced by ancient Polynesian seafarers.

PISCES and the Maunakea observatories celebrated the occasion by sharing their role in the study of the stars and exploration to guide future journeys into the final frontier—space.



Program Director's Message cont...

—one partnering with University of Hawai'i at Manoa researchers on the extraction of volatiles and water from lunar and Mars regolith, and two NASA SBIR (Small Business Innovation Research) grants focused on surface mobility systems. I look forward to seeing the results of these proposals, which will be announced this summer. Unfortunately, we learned that a grant proposal we submitted last fall will not be awarded—however, the feedback we received gave us hope that we can resubmit a modified version of the proposal next fall with a better outcome.

April was also a busy outreach month here at PISCES. We participated in several outreach events including Pohakuloa Training Area's annual Earth Day, the Hōkūle'a voyaging canoe homecoming celebration in Hilo, and Keaukaha Elementary School's student night. I always find it an honor and pleasure to engage with local youth and the community and hope our efforts will inspire future generations to pursue the amazing world of STEM. Along these lines, our 2018 Women's STARS Program will return for the fifth year a row this summer, leading 12 high school women on a five-day adventure across Hawai'i Island. The students will meet and work with leading female scientists, engineers and educators to encourage and inspire them to succeed in their studies and careers. Applications for this program, which is free to attend, are now available online at our website.

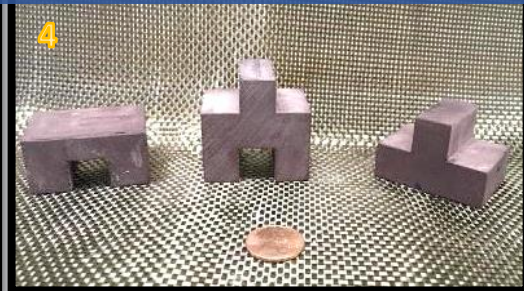
Last month, we also attended two prestigious conferences: ASCE's Earth & Space Conference in Cleveland, Ohio and the 34th Space Symposium in . . .

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Economic Development



PISCES Presents Research Work in Hawaii Basalt at Leading Aerospace Conferences



Above: (1) Romo holds a featherlight rover wheel at NASA's Glenn Research Center during a tour of the facility. (2) L-R: HIEDB Executive Jacqui Hoover, Romo and PISCES Ops. Manager Christian Andersen at the 34th Space Symposium in Colorado Springs. (3) Romo discusses the favorable chemical profile of Hawaiian basalt during a presentation with researchers at E&S. (4) "Planetary LEGOs" exemplify novel uses for Hawaii basalt.

PISCES staff spent much of April traveling across the country to attend top aerospace conferences and forge new partnerships. At ASCE's Earth & Space Conference and the 34th Space Symposium, Director Rodrigo Romo and Geologist Kyla Defore shared PISCES' applied research work in Hawaiian basalt, highlighting its merits as a planetary analog and ISRU feedstock for use on Earth and future space settlements.



2018 Women's S.T.A.R.S. Program

A 5-day summer STEM workshop for Hawaii high school girls



Apply now at pisc.es.hawaii.gov

Sponsored by htdc

Deadline to apply is June 15!

Program Director's Message cont...

Colorado Springs, CO. While vastly different from one another, these conferences align perfectly with the work we do at PISCES. Earth & Space is a technical conference where some of the world's best researchers and scientists gather to share their work in fields related to space construction, mining and engineering. The Space Symposium is a larger event that attracts aerospace industry leaders, business developers, military, multinational companies, and both domestic and foreign government agencies to discuss the future of space exploration from a business and policy standpoint.

Both events proved to be valuable for our work at PISCES and Hawai'i's future role in space exploration. Vice President Mike Pence opened the Space Symposium with a speech outlining the Trump administration's new space directive, which makes the Moon a primary objective. Under this policy, there is renewed interest in field testing at Hawai'i's world-class planetary analog sites in preparation for lunar missions. During the Earth & Space Conference, our research in basalt sintering drew considerable attention and opened new doors for future collaboration. I am hopeful of the opportunities that lie ahead.

A hui hou,

R. Romo

Rodrigo Romo
PISCES Program Director

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Guest Spotlight



What's Missing in ISRU (*in-situ resource utilization*)?

Paul van Susante, PhD

Senior Lecturer, Mechanical Engineering – Michigan Tech

Paul is part of a team studying how to extract water from gypsum—the same technique could one day be used to make water, oxygen and rocket fuel for astronauts.

Many forces—international, economic, political and technological—are lining up for a return to the Moon. Conferences and workshops are multiplying, and it is impossible to visit them all. One of the key drivers of this renewed interest is the commercial space industry.

Visionaries and rocket building companies such as SpaceX, Planetary Resources, TransAstra and many more are planning to mine asteroids and the Moon and colonize Mars. Many of these companies are challenged with generating the cash flow needed to develop and test space mining hardware. As a result, they focus on short-term revenue streams while developing the necessary hardware.

Most companies are focusing on rockets (transportation to the destination), additive manufacturing and prospecting using orbital satellites or telescopes. Mining on Earth is hard. It requires a lot of energy, decades of planning and a lot of in-situ on the ground and drill-core information before a mine may successfully be operated. Many never reach that stage.

Space mining will initially require far less volume in raw material to be processed and thus, energy requirements and equipment sizes can be relatively small. For example, a study for Mars Water ISRU showed that even in the worst-case scenario, only 2,000 metric tons of Martian sand (regolith) would have to be excavated and processed in 480 days. On Earth, a tiny (almost too small to

consider) hard rock mine would process over 1,000 metric tons of hard rock per day with many mines being significantly larger. Of course, there is a huge difference in equipment availability because on Earth I can go to Caterpillar or another vendor and purchase standard equipment like loaders, haulers, drills, etc.

Beyond Earth, no one currently has any true space mining equipment for the required production rates, even in small amounts compared with Earth standards.

Space mining equipment must be automated to work for years in extreme environments (more extreme than the harshest here on Earth) without direct human supervision or maintenance. It is important to develop these off-Earth surface systems now, as the cost of space transportation will become cheaper through private sector efforts in the coming years (the first SpaceX cargo BFR to Mars is already planned for 2022). Some of this work is happening now with NASA SBIR/STTR, ESI and other grants.

Another key element currently missing is the ground data required to properly design mining systems and mine designs. This ground information, gathered by future missions such as the recently cancelled Resource Prospector Mission, would characterize natural 3D spatial variation in location presence, composition, mechanical properties, etc., allowing for accurate assessments, classifications, and improved designs for mining equipment.

These engineering challenges were discussed in-depth at the recent bi-annual Earth & Space Conference organized by the Aerospace Division of the American Society of Civil Engineers (ASCE). The annual Space Resources Roundtable/Planetary and Terrestrial Mining Sciences Symposium (SRR/PTMSS) also served as a forum for discussing these issues.

Design, system integration, field testing, etc. will take years to complete. To speed up and coordinate technology maturation, we are proposing the formation of an ISRU research and development center that would focus on testing and maturing these technologies.

Now is a great time to get involved. There is a lot of work to do before space mining and off-planet colonies can become viable industries. NASA and other space agencies and organizations like PISCES are playing a vital role in developing the technology needed to make these possibilities a reality.

