HAWAII LAND SURVEYORS ASSOCIATION

Lae I Lae A newsletter from the Hawaii Land Surveyors Association, an affiliate of the National Society of Professional Surveyors and a member organization of the American Congress on Surveying and Mapping

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LAE I LAE Point to Point

PRESIDENT'S MESSAGE

Aloha kakou, e na mea ana aina apau,

For those of you who took part, the October 18th Annual Dinner at the Bishop Museum was a fantastic night! It was wonderful to see so many HLSA members and their families come out to talk story and mingle with their Professional Land Surveying Ohana. We were also privileged to have Captain Mark Ellis from the Polynesian Voyaging Society attend and share with us the story and the journeys behind navigating the Hokulea and the Hikianalia around the world, by the stars, the sky, the sea, and the wind. I knew we would be amazed by his presentation, but WOW! What an awe-inspiring chronicle! I'm not sure how we'll match such an exciting ride at next year's Dinner, but rest assured, your Board will do their best (does anyone know any astronauts?)

It must also be stated that without the generous donations of the HLSA Sustaining Members none of the fellowship and story telling that transpired at the Annual Dinner would have been possible. The Sustaining Members have always been the bedrock of our association and I, as a board member and a grateful surveyor, am humbled by their continued support. I know a number of the Sustaining Members were in attendance at the dinner and it was great to see you. Mahalo to you and to all the HLSA Sustaining Members. You are appreciated!

I know for most of us, it can be difficult to make time, right when you want to wind down out of your busy work week, to change up the routine and go talk shop at the Annual Dinners. But what I see each year isn't just more work at the end of a long day. What I see are long acquainted friends taking the time to catch up over a beer (or six. We are surveyors after all). I see colleagues introducing their families to one another and their kids playing together. I see office surveyors getting to know field surveyors and each of them seeing the person, not just the face, that makes the other end of the final work product possible. I see our surveying family growing and getting stronger each year, and it makes me proud to be part of the HLSA Ohana. I know it isn't feasible or even realistic for everyone to attend every HLSA gathering, but I genuinely hope to see each and every one of you whenever you can make it. And I want you to know that when all is said and done, when you were there sharing your time with us, we sure were glad you came.

On a slightly different but no less important topic, HLSA held it's second 2019 workshop on Saturday, October 26 at the excellent Entrepreneur's Sandbox in Kakaako. The topic was on Surveying Basics, and we had four highly regarded and

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incredibly professional land surveyors talk about Azimuth, Distance, Elevation, and Coordinates. Four concepts that we all work with and likely don't know enough about. Kenn Nishihira, Andy Harada, Joanne Williamson, and Wayne Teruya altruistically gave up their Saturday morning to expound on the many intricacies around these topics and for that we are grateful. We had full attendance and based on the turn out for the first two workshops HLSA is expecting to have to book a larger room for the next one. It helps that MEMBERS CAN ATTEND FOR FREE!!!!! So don't be shy, if you want to pick the brain of some of the most knowledgeable surveyors in Hawaii today, please RSVP for any of the workshops you see coming down the pipe. Speaking of which, HLSA will be holding another workshop, this time on the topic of Hawaiian Land Titles, on a date yet to be determined. The holidays are coming up so the Board will discuss when the best time to hold it will be. If you have any feedback on our previous workshops, or suggestions on workshops you would like to see, please feel free to contact your Board. We are here to help but we need you to help us help you. Mahalo nui to all of you and we look forward to seeing you March 5th and 6th at the 2020 conference!

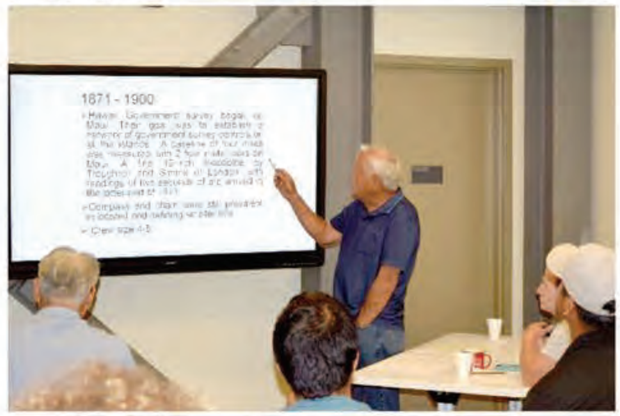
Oh, and if you see any of your Board members, please thank them profusely. Joanne Williamson, Christina Villa, Karl Nishio, Alika Garo, Donna Gonzales, Cliff Yim, Leo Bell and Erick Wenceslao have all worked diligently and tirelessly to make these kinds of events happen, not to mention all the work they do behind the scenes. Your Board is truly committed to HLSA and its members and we are all lucky to have them supporting us.

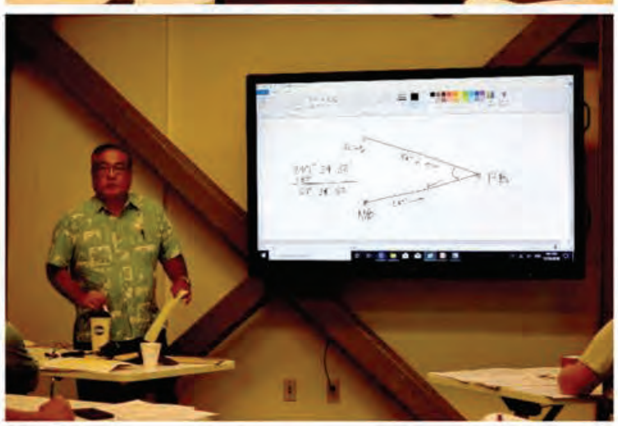
Mahalo nui a me ke aloha,
Meyer Cummins, LPLS
2019 HLSA President

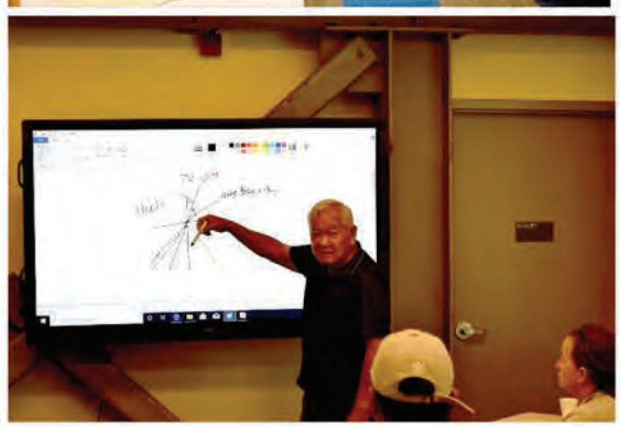
2019 Basic Survey Math Workshop

October 26, 2019

By: Andy Harada, LPLS (ESH); Kenn Nishihira, LPLS (KN Surveying); Wayne Teruya, LPLS (ParEn, Inc.); and Joanne Williamson, LPLS (HECO)







2020 VENDORS NEEDED!

Please join us for our upcoming *2020 Annual Hawaii Land Surveyors Conference* which will be held at the Pomaikai Ballrooms at Dole Cannery Iwilei on March 5th and 6th, 2020. We're looking for vendors that would like to participate in the opportunity to showcase their product to our surveying community. It's a great way to meet new people and expand your clientele. For further information and for registration forms please email hlsa-hawaii@outlook.com. Don't hesitate, those who submit their registration forms paid in full get first choice to where they would like to be situated in the foyer. We look forward to seeing you there!

Our past vendors that have participated over the years...

Aerotas
Bentley Systems
Carlson Software
Dudek
ESRI
Frontier Precision
Hawaii State Energy Office
Hubs Hawaii
JAVAD
Pacific GPS
Spectra Precision
Surveyors Supply Co.

2020 SPEAKERS NEEDED TOO!!

Not only are we looking for vendors, but we also need speakers that would like to volunteer their time to help impact our profession. The speaker's session is 50-minutes long. If your topic may need an extra session, please contact as soon as possible so we can assist you. Conference attendees have valued the information they received from these sessions. It helps our Land Surveyors grow and better themselves in the profession. For further information and for registration forms please email hlsa-hawaii@outlook.com. Please submit your registration forms as soon as possible, this will help you get a spot on the schedule of your choice.

A Tale of Two Feet

NOAA, NIST prepare to **drop U.S. survey foot and adopt the international survey foot** in a move towards more precise positioning.

Story from the National Oceanic and Atmospheric Administration website.

Our vision at NOAA's National Geodetic Survey is that everyone accurately knows where they are and where other things are at all times and in all places.

— Brett Howe, NGS geodetic services division chief

Since 1959, land surveyors and other geospatial professionals have had two standards to measure the length of a foot — the U.S. survey foot and the international foot. Both have been supported by NOAA's National Geodetic Survey and the National Institute of Standards and Technology. And they're not exactly equal.

The difference between the two measurements is very small and barely noticeable in everyday use and is a function of their relationship to the standard meter. A U.S. survey foot is expressed as a fraction — 1200/3937 meters — while an international foot is expressed as a decimal, exactly 0.3048 meters. That's a difference of only one one-hundredth of a foot per mile.

But when you begin to measure or use coordinates that span hundreds or thousands of miles, that minor difference can reach a few to several feet. In such cases, accidentally confusing the two types of feet can severely impact the precise coordinates and measurements used in engineering, surveying, mapping, agriculture, and other industries that depend on accurate positions.

NOAA surveyors Charles Geoghegan and Benjamin Erickson conducting a geodetic surveying project in Colorado in the summer of 2017.

That's why NIST and NOAA are retiring the U.S. survey foot, and standardizing on the international foot. And the modernization of the National Spatial Reference System, a precise coordinate system that defines latitude, longitude, height, scale, gravity and orientation throughout the U.S. in 2022, is the perfect time to move the U.S. toward a single, uniform definition of the foot.

"Our vision at NOAA's National Geodetic Survey is that everyone accurately knows where they are and where other things are at all times and in all places," said Brett Howe, geodetic services division chief at NGS. "To that end, working with NIST on removing this confusion is a step in the right direction for precise positioning applications."

NGS and NIST will issue public notices to solicit public comments in order to ensure a smooth transition to the new standard. Once this step is taken, American surveyors will be starting out on the right foot or, more precisely, the same foot.

https://oceanservice.noaa.gov/geodesy/international-foot.html

NASA’s Space Geodesy Project Mapping Out a Bright Future

By: Jessica Merzdorf
NASA's Goddard Space Flight Center, Greenbelt, Md.

In April 2019, an international team of more than 300 scientists unveiled the first recorded images of a black hole, its dark shadow and vivid orange disk peering back across 55 million light years of space. Capturing images from so far away required the combined power of eight radio telescopes across four continents, working together to essentially form a massive Earth-sized telescope called the Event Horizon Telescope (EHT).

The technology that powers EHT imaging is also used by scientists at NASA and worldwide to measure the Earth. Very long baseline interferometry, or VLBI, is a technique that combines waveforms recorded by two or more radio telescopes. This versatile tool is used not only in astronomy, but also geodesy: The science of measuring Earth’s size, shape, rotation and orientation in space.

Geodesy lets us see maps on our phones, measure ocean tides, plan rocket launches, calibrate clocks, forecast earthquakes, track tsunamis and maintain satellite orbits. As a geodetic tool, VLBI helps scientists precisely measure distances and topography and track changes to Earth’s surface and rotation over time. Scientists at NASA’s Goddard Space Flight Center in Greenbelt, Maryland, and MIT’s Haystack Observatory in Westford, Massachusetts, pioneered the geodetic use of VLBI in the 1960s.

Today, NASA, MIT Haystack and other partners collaborate to improve and expand geodetic stations around the world as part of NASA’s Space Geodesy Project (SGP). MIT Haystack serves as the hub for hardware and software development that benefits both astronomy and geodesy, partnering with the National Science Foundation to support the EHT and with NASA to boost the SGP. Together, that synergy contributed directly to realizing the black hole image while working towards smaller, faster radio telescopes, more automation and access to multiple geodetic tools in the same place, enabling more precise maps, charts, flight paths and orbits than ever before.

VLBI: All About That Baseline

Radio telescopes measure radio waves. These waves are weaker and fainter than visible light, but they penetrate interstellar dust and gases and interference from Earth’s own atmosphere in ways that visible light cannot. They also give astronomers information about space that does not exist in the visible spectrum.

In 2007, the National Academy of Sciences reported that the nation's geodesy infrastructure was aging too quickly to keep up with growing demands for data. So NASA launched the Space Geodesy Project to develop and deploy the next generation of geodetic stations, which includes VLBI. This radio telescope in Texas is one of the updated telescopes. ***Credits: Eusebio Terrazas, University of Texas***

Viewing radio waves requires large, sensitive telescopes. A VLBI array has magnifying power, or "angular resolution," equivalent to a single telescope with a dish as wide as the longest baseline between two telescopes in the array. (For example, the EHT's most distant telescopes were separated by more than 7,000 miles, equaling a single telescope more than twice as wide as the United States.) Each telescope in the EHT array captured the radio waves emitted by the black hole from a unique angle, depending on their location on Earth. Adding all these observations together with a powerful computer yielded the final images.

In the 1960's, scientists at NASA Goddard and MIT Haystack realized that this slight difference in perspective was a valuable source of information — not just about space, but about Earth.

"The basic principle of geodetic VLBI is that radio waves coming in from a distant source hit one station before the other," said Stephen Merkowitz, manager of NASA's Space

Geodesy Project. “We use quasars, which are very distant active galaxies, so far away that they are fixed points in the sky. We measure the time delay between when the signal hits those two points, and convert to a distance using the speed of light.”

Earth's rotation causes changes to the time delay between the quasar signals observed by the VLBI stations, allowing scientists to precisely measure the rotation's speed. They can also use this data to measure the location and distance between the VLBI stations, and by repeating these measurements over time, can observe even tiny, slow changes to the Earth’s surface, like continental drift.

Perhaps VLBI’s most important function is helping to build the International Terrestrial and Celestial Reference Frames. The Terrestrial Reference Frame assigns coordinates to locations on Earth, including its center, providing a consistent framework to relate measurements to each other.

“Suppose you have a mission that measures the sea level in the Gulf of Mexico and have a tide gauge off the coast of Louisiana that is also taking sea level measurements, and you want to tie those together so you have some ground truth to the space observations,” Merkowitz said. “If they’re not in the same reference frame, you can’t do that. If your frame isn’t precise and stable, that will introduce all kinds of errors into that tie. So, a good reference frame allows you to connect different data sets through geolocation.”

The Celestial Reference Frame serves a similar purpose, but instead of creating a stable framework for Earth locations, it creates a framework for locating astronomical objects. Scientists use Earth Orientation Parameters — measurements of time, orientation and rotation — to link the two frames together. This creates a total system to geolocate objects in space and on Earth.

One example of an everyday technology that depends on these reference frames is the Global Positioning System, or GPS. GPS relies on a constellation of satellites constantly broadcasting their locations and times to GPS-enabled devices on the ground, from cell phones to farm equipment. The satellites in the constellation rely on the Terrestrial Reference Frame and the Earth Orientation Parameters to relay their location, so keeping those frameworks precise and accurate is essential for daily activities around the world.

Quantities we sometimes take for granted, like the length of Earth’s day and how fast it rotates, are not actually constant, Merkowitz said. “They depend on lots of different things like weather, major mass motions like El Niño or La Niña, and movements of large amounts of water," he explained.

With Earth constantly changing, geodesy keeps maps accurate, planes and ships on course and satellite measurements precise. In fact, VLBI and other tools are vital for Earth-observing satellites like ICESat-2 and instruments like GEDI, both of which use laser pulses to measure the structures of ice sheets and forests. Without knowing exactly where the spacecraft are located above Earth's surface, scientists wouldn't be able to make these kind of precision measurements.

"When you do precision orbit determination for something like ICESat-2, it requires the reference frame as input," Merkowitz said. "ICESat-2 is very sensitive to errors, so if the calculation of Earth's center is off, it translates into an error in the science measurements. Precision orbit missions and missions that measure heights are particularly dependent on the framework."

In 2007, the National Academy of Sciences reported that the nation's geodesy infrastructure was aging too quickly to keep up with growing demands for data. So NASA launched the Space Geodesy Project to develop and deploy the next generation of geodetic stations, which includes VLBI as well as other techniques that use lasers to precisely track satellites (called satellite laser ranging, or SLR).

The new VLBI stations will be able to sample across a broad range of frequencies instead of just two, giving them more flexibility to keep collecting data if there is interference from Wi-Fi or other signals. Their smaller size and quicker movement will make them more adaptable to atmospheric conditions, but to make up for the smaller dishes (remember, with radio telescopes, bigger is better), they will sample data much faster. Eventually, Merkowitz said, the systems will be able to collect data 24 hours a day without human supervision to provide much more rapid measurements.

The National Academy of Sciences and other international geodetic associations recommend that, for the best science outcomes, the updated Space Geodesy Network should be accurate to within one millimeter, or about the thickness of an ID card. It should also be stable to within one-tenth of a millimeter — the width of a human hair. This precision is crucial for measuring sea levels, which are increasing at about 3.4 millimeters, or 0.13 inches, per year, Merkowitz said.

The project is in its first phase: replacing NASA's domestic geodetic stations with the next-generation systems. NASA recently installed its third domestic VLBI station in

Texas; its next-generation VLBI stations in Hawaii and Maryland are already in operation and routinely taking measurements.

NASA is also working with international partners to help transition the international VLBI network to the next-generation technology, Merkowitz said. “International cooperation is vital to the success of space geodesy. Measuring global effects requires a global network, and NASA cannot do this alone.”

The next-generation network will support more precise GPS, increasingly precise reference frames and better support for the many ways we use maps in today’s world. With the help of VLBI, the team will help us know where we are – and where we’re going – with even more accuracy in the future.