LOST IN SPACE

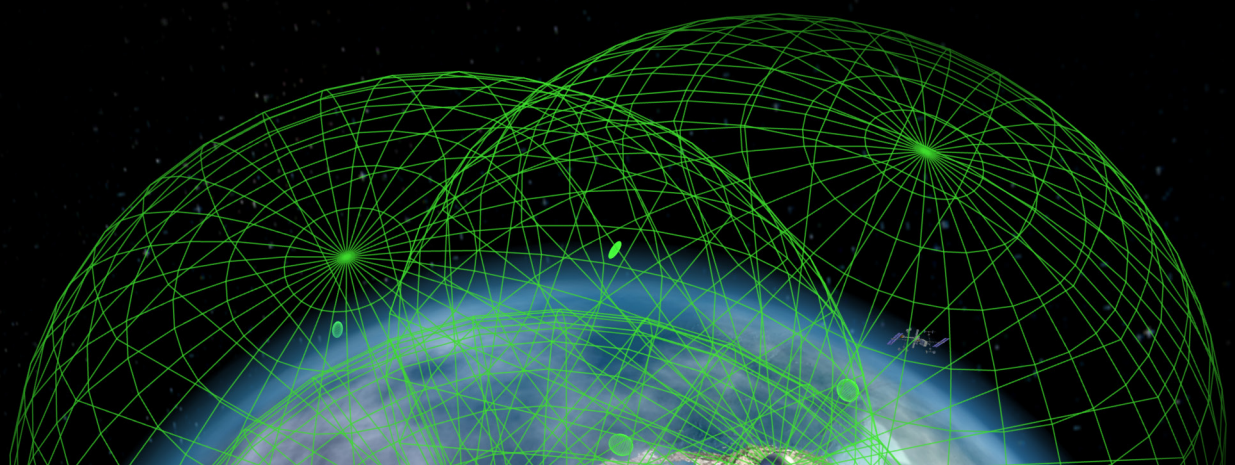
Oceanit's global surveillance network tracks orbiting satellites, debris, and asteroids

Remember when almost the only objects visible in the night sky were natural: the moon, stars, meteors, and comets? Probably not, because all that changed in the late 1950s with the expansion of commercial air travel and the launch of Sputnik, the first artificial earth satellite. Since then, thousands of space-based objects, including derelict spacecraft and Elon Musk's red Tesla roadster, litter the heavens. According to the United States Strategic Command, there are 17,852 unnatural objects orbiting the Earth large enough to be tracked, and literally millions of bits of debris, smaller than 10 cm, that are difficult to see.

Debris can collide with other objects, including satellites or even the International Space Station (ISS), to dangerous effect. As a result, in 1979, the National Aeronautics and Space Administration (NASA) developed their Orbital Debris Program. Since then, space has been increasingly militarized with spy and eavesdropping satellites, the Global Positioning System (GPS), and defense communications systems.

So how do we know what's up there?

Oceanit, a Honolulu, Hawaii-based small business, founded in 1985 by Dr. Patrick Sullivan, has



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the answer. An innovative 'Mind to Market' company, Oceanit transforms concepts from fundamental science into products and services, including sensor and communication systems, software, and advanced materials—such as coatings, fabrics, and industrial products—for both commercial and military users.

With support from the Department of Defense's (DoD) Small Business Innovation Research (SBIR) program, Oceanit developed the High Accuracy Network Determination System (HANDS). HANDS provides continuous autonomous tracking of space objects 22,000 miles above Earth. The technology was built as a global network of autonomous telescopes to accurately track space-based objects by fusing observations from many sites around the world.

Dr. Sullivan credits the SBIR program with reducing the technical and market risks, making it possible for Oceanit to create this innovative technology.

Sullivan, Oceanit's chief executive officer, described HANDS as being similar to an air traffic control system for space. "We can characterize satellites, asteroids, and debris. There are so many objects in space now. The debris patch has gotten huge and space is more congested than ever. There are military players and communications satellites, which we all rely on. In addition, small companies are putting up inexpensive objects that can work in swarms, changing the economics of sending satellites into space. We created the ability to track space objects 24 hours a day, seven days a week, for minimal cost."

In the 1990s, the DoD's Air Force Research Lab (AFRL) was interested in investing in new ideas for Space Situational Awareness (SSA). Oceanit, true to its reputation of being willing to try new things, was an early pioneer in the field. SSA monitors everything in the near-earth environment, including the sun, solar wind, ionosphere and thermosphere. It detects near-earth objects (NEO) such as asteroids, and active and inactive satellites. In the early years, SSA was predominantly conducted via a few big radar stations run by National Laboratories.

During their research, Oceanit demonstrated that small optics, connected around the planet, could provide accurate and valuable information on low-earth orbit (LEO) and high-earth orbit (HEO), including geosynchronous earth orbit (GEO) objects, rather than relying on the larger radar stations.

"We demonstrated that we could collect quality optic information for a fraction of the cost of traditional methods (i.e. large optics). We started with a Phase I Small Business Innovation Research (SBIR) contract to develop the concept. In Phases II and III we further developed and ultimately built the HANDS global network system," said Sullivan.

Until Oceanit started building and testing HANDS, the AFRL was doubtful the required accuracy could be achieved. Scientists and engineers at AFRL were certain that the physics would not work.

Dr. Sullivan said, "Through another project, we learned that one inexpensive, simple sensor had little value, but aggregating data from many small sensors could provide value in spades. We then turned the problem to the sky and thought we could do this for space. We showed the Air Force the data, proving the science and creating new ways to think about what is actually possible. The biggest achievement was to meet the challenge of demonstrating sub arcsecond accuracy with small optics. We had the confidence to experiment and demonstrate results. And we did. Data speak volumes over a powerpoint presentation. The SBIR program gave us the flexibility to explore the possibilities."

Dr. Patrick Sullivan

Oceanit built a system of 9 to 10 stations and could track 95 percent of

Global network locations of HANDS telescope sites.

space all day, every day. They ran the initial proof-of-concept system as a full-scale pilot demonstration for several years, feeding data into a classified network. Then they developed the fully autonomous, operational and secured HANDS system.

While the achievements were monumental, there were challenges along the way. For example, in some remote locations, the Oceanit team had to build domes to protect their equipment from rat infestations. And the initial version had been built on an unstable software platform that kept crashing, requiring them to switch to another, more robust program. Throughout the ups and downs, Dr. Sullivan credits the SBIR program with reducing the technical and market risks, making it possible for Oceanit to create this innovative technology.

"We had problems (that) we could not imagine until we were in them. We had to rebuild things because, as we have learned over and over, innovation is messy. So, we continuously saw what worked, improvised, and upgraded accordingly. If you're willing to discover and are open to learning along the way, there is no limit to what you can do," said Sullivan.

Oceanit is leveraging insights from HANDS for other discoveries, such as a synthetic optic nerve that can be used for high-agility robotics including autonomous cars, and smart materials with myriad applications.

"When we first developed HANDS, the potential security threat in space was much smaller than it is today. With the emergence of China and other countries developing space agendas, the U.S. interest has significantly increased. Plus, commercial space has made "the final frontier" much more accessible to just about anyone, making HANDS more relevant than ever. Oceanit is also working on other technologies that can be employed to find responsible solutions to combat some of the world's most difficult problems like climate change, health and wellness, and others," said Sullivan.

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