Air Force SBIR STTR TRANSITION
EQUIPPING THE WARFIGHTER

SOFTWARE CODE SIGNIFICANTLY IMPROVES TELESCOPE CLARITY

TOPIC NUMBER:
AF103-017

TOPIC TITLE:
Multi-Frame Blind Deconvolution Algorithms for Daylight and Strong Turbulence

CONTRACT NUMBER:
FA9451-12-C-0004

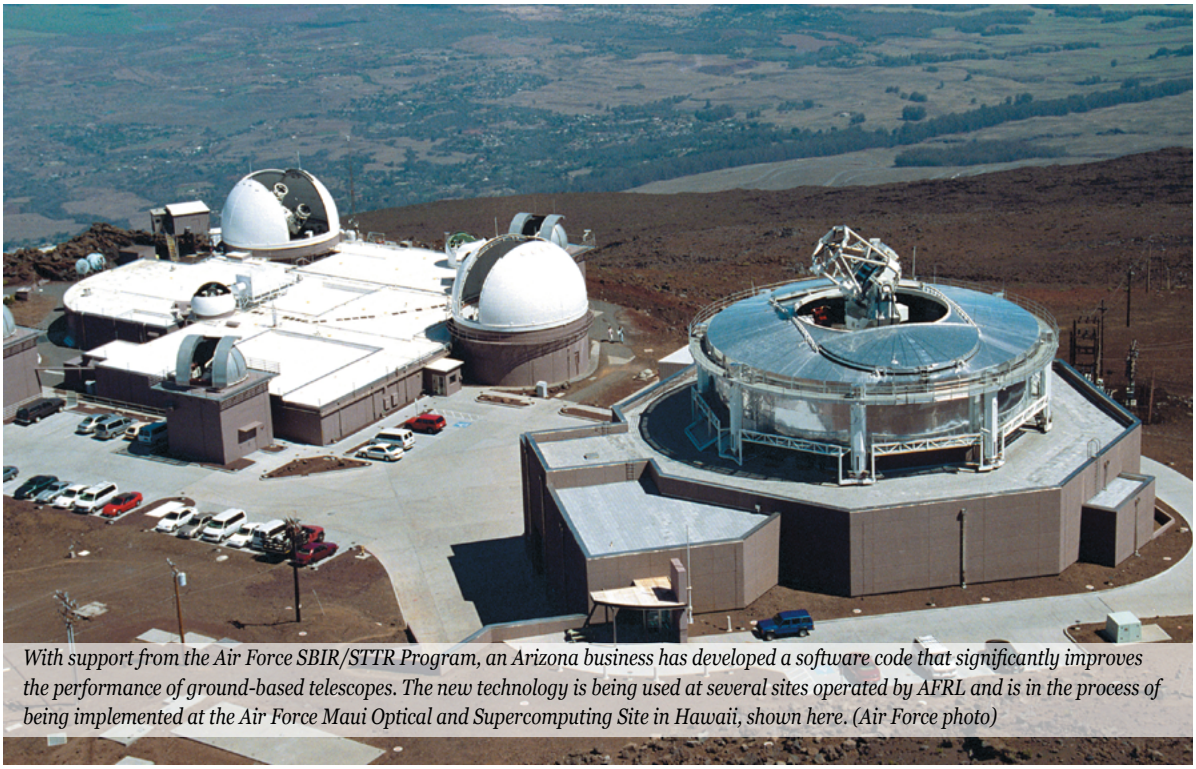
SBIR COMPANY NAME:
Hart Scientific Consulting International LLC, Tucson, AZ

TECHNICAL PROJECT OFFICE:
AFRL Directed Energy Directorate, Maui Optical and Supercomputing Site, HI

SPONSORING ORGANIZATION:
Air Force Research Laboratory

PUBLISHED:
February 2018

88ABW-2018-0606



With support from the Air Force SBIR/STTR Program, an Arizona business has developed a software code that significantly improves the performance of ground-based telescopes. The new technology is being used at several sites operated by AFRL and is in the process of being implemented at the Air Force Maui Optical and Supercomputing Site in Hawaii, shown here. (Air Force photo)

NEW TECHNOLOGY BOOSTS THE ABILITY OF GROUND-BASED TELESCOPES TO BE EYES IN SPACE

If a satellite being used to spot camouflaged weapons systems was suddenly knocked offline, allied personnel in the field would immediately be in greater danger. The outage would be followed by a scramble for answers: Was the satellite damaged by debris or an act of sabotage? Could its functionality be restored or is the capability lost?

The most viable option for a quick assessment – pointing a high-power telescope at the satellite – would likely provide little more than blurred images. However, the Air Force and a small business partner may have solved that problem as part of a larger contribution to space situational awareness.

continued >

With support from the Air Force Small Business Innovation Research/Small Business Technology Transfer Program, Arizona-based Hart Scientific Consulting International LLC developed software code that greatly improves the ability of large ground-based telescopes to see satellites in space. By applying this technology to view the satellite that went offline, for example, analysts would be able to see key features of the spacecraft and more quickly diagnose the issue.

Also known as DORA – for Daylight Object Restoration Algorithm – the technology is now being used at several sites operated by the Air Force Research Laboratory and is in the process of transitioning to the Air Force Maui Optical and Supercomputing Site in Hawaii, according to Ryan Swindle, a research physicist at AFRL's Directed Energy Directorate. The transition is scheduled to be complete in the third quarter of 2018.

BETTER SPACE SITUATIONAL AWARENESS

The U.S. has a growing, critical national interest in space. This includes maintaining the health of our orbital assets, and that of our allies, while being constantly aware of the capabilities and movements of spacecraft operated by adversaries.

Space situational awareness, the mission to keep tabs on space-based assets, is supported through a variety of sensors and other tools, including large telescopes. In theory, these telescopes should deliver high-resolution images of satellites. However, turbulent winds in the Earth's atmosphere degrade the quality of their images in the same way that leads to the twinkling of starlight.

Additionally, data collection with telescopes during the day is a challenge because the bright sky background masks satellite views. This restriction greatly hampers the timeliness of data collection on most satellites and makes it extremely challenging to collect any useful data on a particular class of strategically important satellites in sun-synchronous orbit.

DORA is designed to help offset atmospheric effects and overcome the restricted timing aspects of data collections, thereby restoring images to the sharpness as if a telescope were in space itself. This enables faster response times and a greater throughput by allowing telescopes to be operated more often and over a larger area of the observable sky.

As a result, the new technology provides space situational awareness analysts with more unobscured views of the objects they are attempting to see.

"The DORA program will have a major impact on space situational awareness by greatly expanding the range of conditions under which actionable information can be collected by existing, and future, Department of Defense facilities," said Michael Hart, president of Hart Scientific.

BEHIND THE TECHNOLOGY

In developing DORA, Hart Scientific fully exploited the physics of the image formation process and the behavior of the atmosphere that leads to image blurring. Many key elements of the new technology, which model physical principles of the image formation process, had never been tested before.

Funding from the Air Force SBIR/STTR Program allowed these tests to be carried out – both in simulation and with real data – so the elements could be successfully integrated into the final algorithm.

This project also allowed Hart Scientific to hire additional staff, expand its technical expertise and develop related products in optical hardware for wavefront sensing and adaptive beam control that are now part of the company's catalog.