

## Proving a technique

### *AMOS presentation analyzes capabilities of image sampling methodology*

Air Force astrophysicist Capt. Anthony O'Dell may be offering new life to a decades-old image sampling theory for detection of Near Earth Objects by ground-based telescopes.

O'Dell will present his findings in an investigation of the Nyquist sampling theorem applied to large field sky scans, indicating the technique can improve detection of higher visual magnitude objects, at the 2009 AMOS Conference on Maui.

Based on computer simulations, O'Dell says Nyquist sampling methodology with cross correlation of a point spread function will outperform Rayleigh sampling, and increase the advantage for objects at increased distance from the center of field-of-view of the imaging device pixel.

His simulations were for a 20.7 visual magnitude object – estimated by NASA at 210 to 470 meters in diameter at 1 AU. (Visual magnitude is an astronomy system for rating brightness of objects, with higher numbers indicating less bright. The moon would be rated at minus-10, while the smallest object that can be seen unaided would rate at about 6 to 7 visual magnitude.)

O'Dell said the Nyquist sampling methodology increases the potential for ground-based telescopes to sight even higher visual magnitude objects – with a goal of compliance with a congressional mandate to detect 90 percent of Near Earth Objects of 140 meters or larger.

The presentation, “Improving the Detection of Near Earth Objects for Ground-Based Telescopes,” is scheduled for an afternoon presentation on Sept. 2, as part of a session on imaging during the first full day of the conference being held at the Wailea Beach Marriott Resort.

“While Nyquist is common in other fields, this would be a new application of it in the field of searching for Near Earth Objects. Until recently, CCD (charge coupled device) technology did not allow for high resolution imaging,” he said.

AMOS (Advanced Maui Optical and Space Surveillance) Technologies Conference focuses on space situational awareness – the science and technology involved in detecting, monitoring and characterizing objects in space that may affect the Earth.

The conference was initiated by the Maui Economic Development Board and the Air Force Research Laboratory, which operates the Maui Space Surveillance System (MSSS). Maui Economic Development Board co-hosts the conference to support the MSSS and its ancillary programs and to promote science and technology opportunities on Maui.

“Quite often, presentations are an update on ongoing research and developments of technology, all within the field of space situational awareness,” conference Co-Chairman Wes Freiwald said.

But the four-day gathering offers an annual opportunity for researchers in the specialized field to share information that may not be available otherwise with colleagues from around the world.

“In a lot of cases, this is THE forum for scientists to discuss their research activities since it's difficult to have them all together in the same place,” Freiwald said. “It's very important for researchers to understand what other researchers have done just for the simple reason of avoiding duplication, but also to leverage findings and to collaborate and to advance research activities.”

The 2009 version will include a series of presentations from Russian and U.S. scientists involved in evaluating a unique event, the Feb. 10 Iridium-Cosmos collision in which an obsolete Russian Cosmos satellite and an Iridium communications satellite crashed 490 miles above Earth.

Satellite tracking is the major element in space situational awareness. The collision sparked a reevaluation of satellite monitoring capabilities and raised concerns over the effects of a massive amount of debris spreading in Earth orbit.

A Russian scientist, Vladimir Agapov with the Vympel Corp., is scheduled to present an analysis of the errors in calculations of the Cosmos orbit in the time leading up to the collision. T.S. Kelso with the Center for Space Standards & Innovation is scheduled to present an analysis of available systems for satellite operators to screen for close approaches and limits on available information for predicting close approaches.

Other sessions will deal with orbital debris, effects of atmospheric turbulence on ground-based observations, developments in wide-field telescope capabilities and related updates on optics and sensor development.

"It's about ongoing processes," Freiwald said. "What makes this year's conference a little different from previous conferences is that we have a definite event to report on, the Iridium-Cosmos collision. Other projects are showing progress and some are most more slowly.

"But if you consider the reports that have been presented over the past 10 years in every field, there have been huge research advances made. If you look at the number and quality of the presentations and the evidence of advancement of research, it's been excellent."

In that respect, O'Dell's presentation of his year of research into the potential for utilizing Nyquist sampling for detection of Near Earth Objects may be typical. It's an initial step in a research effort that may take several more years to be proved and to pay dividends.

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The 2009 AMOS Conference is a gathering of specialists in astronomy, imaging and optical systems providing updates on ongoing research and discoveries in space situational awareness.

It will be held Sept. 1 through 4 at the Wailea Beach Marriott Resort, presented by the Maui Economic Development Board.

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A featured subject for the 2009 conference is the Iridium-Cosmos Collision, the crash of a nonoperational Cosmos 2251 satellite into an Iridium communications satellite at 490 miles altitude over Siberia on Feb. 11.

Freiwald is president of Pacific Defense Solutions. He is AMOS co-chairman with Paul Kervin, chief scientist with the Air Force Research Laboratory's Maui Space Surveillance System.

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