generated side-information and the Slepian-Wolf code bits.

The video coding element includes receiving a first reference frame having a first pixel value at a first pixel position, a second reference frame having a second pixel value at a second pixel position, and a third reference frame having a third pixel value at a third pixel position. It determines a first motion vector between the first pixel position and the second pixel position, a second motion vector between the second pixel position and the third pixel position, and a fourth pixel value for a fourth frame based upon a linear or nonlinear combination of the first pixel value, the second pixel value, and the third pixel value. A stationary filtering process determines the estimated pixel values. The parameters of the filter may be predetermined constants.

This work was done by Ligang Lu, Drake He, Ashish Jagmohan, and Vadim Sheinin of IBM for Stennis Space Center.

Inquiries concerning rights for the commercial use of this invention should be addressed to:

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Refer to SSC-00291/309/310, volume and number of this NASA Tech Briefs *issue, and the page number.*

Apparatus for Measuring Total Emissivity of Small, Low-Emissivity Samples

Goddard Space Flight Center, Greenbelt, Maryland

An apparatus was developed for measuring total emissivity of small, lightweight, low-emissivity samples at low temperatures. The entire apparatus fits inside a small laboratory cryostat. Sample installation and removal are relatively quick, allowing for faster testing.

The small chamber surrounding the sample is lined with black-painted aluminum honeycomb, which simplifies data analysis. This results in the sample viewing a very high-emissivity surface on all sides, an effect which would normally require a much larger chamber volume. The sample and chamber temperatures are individually controlled using off-the-shelf PID (proportional–integral–derivative) controllers, allowing flexibility in the test conditions. The chamber can be controlled at a higher temperature than the sample, allowing a direct absorptivity measurement.

The lightweight sample is suspended by its heater and thermometer leads from an isothermal bar external to the chamber. The wires run out of the chamber through small holes in its corners, and the wires do not contact the chamber itself. During a steady-state measurement, the thermometer and bar are individually controlled at the same temperature, so there is zero heat flow through the wires. Thus, all of sample-temperature-control heater power is radiated to the chamber.

Double-aluminized Kapton (DAK) emissivity was studied down to 10 K, which was about 25 K colder than any previously reported measurements. This verified a minimum in the emissivity at about 35 K and a rise as the temperature dropped to lower values.

This work was done by James Tuttle and Michael J. DiPirro of Goddard Space Flight Center. For further information, contact the Goddard Innovative Partnerships Office at (301) 286-5810. GSC-15697-1

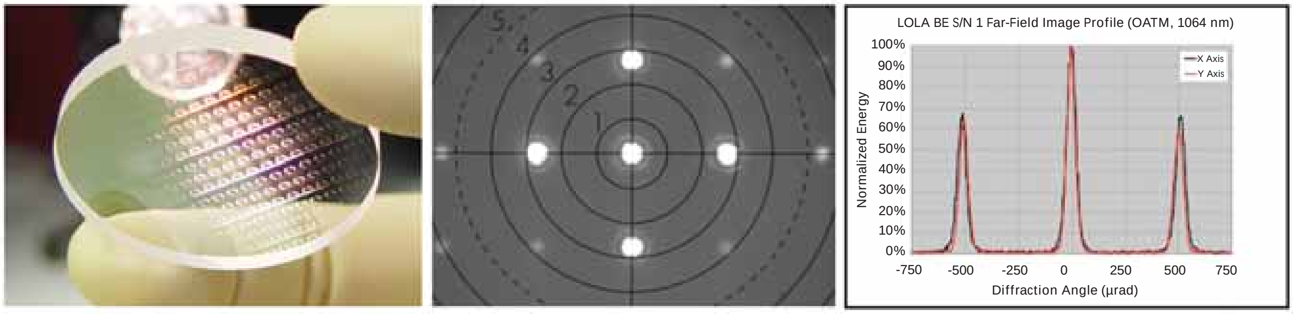
Multiple-Zone Diffractive Optic Element for Laser Ranging Applications

This technology can be used on unmanned aerial vehicles, or in collision-avoidance and robotic control applications in cars, trains, and ships.

Goddard Space Flight Center, Greenbelt, Maryland

A diffractive optic element (DOE) can be used as a beam splitter to generate multiple laser beams from a single input laser beam. This technology has been recently used in LRO's Lunar Orbiter Laser Altimeter (LOLA) instrument to generate five laser beams that measure the lunar topography from a 50-km nominal mapping orbit (see figure). An extension of this approach is to use a multiple-zone DOE to allow a laser altimeter instrument to operate over a wider range of distances. In particular, a multiple-zone DOE could be used for applications that require both mapping and landing on a planetary body. In this case, the laser altimeter operating range would need to extend from several hundred kilometers down to a few meters.

The innovator was recently involved in an investigation how to modify the LOLA instrument for the OSIRIS asteroid mapping and sample return mission. One approach is to replace the DOE in the LOLA laser beam expander assembly with a multiple-zone DOE that would allow for the simultaneous illumination of the asteroid with mapping and landing laser beams. The proposed OSIRIS multiple-zone DOE would generate the same LOLA five-beam output pattern for high-altitude topographic mapping, but would simultaneously generate a wide divergence angle beam using a small portion of the total laser energy for the approach and landing portion of the mission. Only a few percent of the total laser energy is required for approach and landing operations as the return signal increases as the inverse square of the ranging height. A wide divergence beam could be implemented by making the center of the DOE a diffractive or refractive negative lens. The beam energy and beam divergence characteristics of a multiple-zone DOE could be easily tailored to meet the requirements of other missions that require laser ranging data.



(a) (b) (c)

LOLA DOE: (a) Picture, (b) Far-field image, and (c) Image normalized cross-section.

Current single-zone DOE lithographic manufacturing techniques could also be used to fabricate a multiple-zone DOE by masking the different DOE zones during the manufacturing process, and the same space-compatible DOE substrates (fused silica, sapphire) that are used on standard DOE's could be used for multiple-zone DOE's.

DOEs are an elegant and cost-effective optical design option for space-based laser altimeters that require multiple output laser beams. The use of multiple-zone DOEs would allow for the design and optimization of a laser altimeter instrument required to operate over a large range of target distances, such as those designed to both map and land on a planetary body. In addition to space-based laser altimeters, this technology could find applications in military or commercial unmanned aerial vehicles (UAVs) that fly at an altitude of several kilometers and need to land. It is also conceivable that variations of this approach could be used in land-based applications such as collision avoidance and robotic control of cars, trains, and ships.

*This work was done by Luis A. Ramos-Izquierdo of Goddard Space Flight Center. Further information is contained in a TSP (see page 1)***.** *GSC-15620-1*

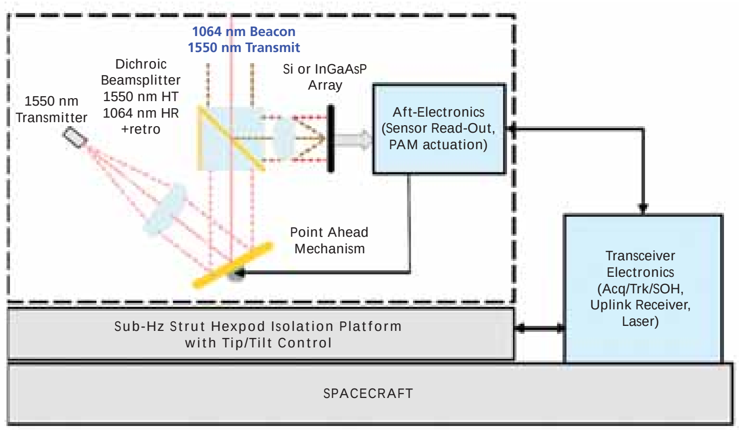
Simplified Architecture for Precise Aiming of a Deep-Space Communication Laser Transceiver

New optical transceiver is a combination of innovative technologies.

NASA's Jet Propulsion Laboratory, Pasadena, California

The simplified architecture is a minimal system for a deep-space optical communications transceiver. For a deep-space optical communications link the simplest form of the transceiver requires (1) an efficient modulated optical source, (2) a point-ahead mechanism (PAM) to compensate for two-way light travel, (3) an aperture to reduce the divergence of the transmit laser communication signal and also to collect the uplink communication signal, and (4) a receive detector to sense the uplink communication signal. Additional components are introduced to mitigate for spacecraft microvibrations and to improve the pointing accuracy.

The Canonical Transceiver implements this simplified architecture (see figure). A single photon-counting "smart focal plane" sensor combines acquisition, tracking, and forward link data detection functionality. This improves optical efficiency by eliminating channel splits. A transmit laser blind sensor (e.g. silicon with 1,550-nm beam) provides transmit beam-pointing feedback via the two-photon absorption (TPA) process. This vastly improves the transmit / receive isolation because only the focused transmit beam is detected. A piezoelectric tip-tilt actuator implements the required point-ahead angle. This point-ahead mechanism has been demonstrated to have near zero quiescent power and is flight qualified. This architecture also uses an innovative 100-mHz resonant fre-



The **Canonical Transceiver Architecture** simplifies the design of the deep-space optical transceiver. Innovative technologies enabling its implementation include a single photon-counting detector array, two-photon absorption downlink tracking, a low-power point-ahead mechanism, and a sub-Hertz vibration isolation platform.