on binary signal detection (the curves labeled "Helstrom bound" in Figures 1 and 2) is known as the Dolinar receiver. This approach applies a rapidly time-varying local laser field to the signal during each bit-interval, but such time-varying fields are difficult to generate in practice at high data rates. In addition, the phase and sign of the local laser fields must be switched instantaneously with the detection of each new photon for best performance, placing significant burdens on the processing speed of the receiver and on the response of the local laser. The proposed solution overcomes these problems by employing constant local laser intensities that can be pre-computed based on estimates of signal-strength, while attaining nearly the same bit-error rate as the more complex quantum-optimum receiver. The solution proposed here will therefore enable high-sensitivity deep-space optical communications at data rates up to gigabits/second as required for future deep-space optical communications.

This work was done by Victor A. Vilnrotter of Caltech for NASA's Jet Propulsion Laboratory. For more information, contact iaoffice@jpl.nasa.gov.

In accordance with Public Law 96-517, the contractor has elected to retain title to this invention. Inquiries concerning rights for its commercial use should be addressed to:

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Refer to NPO-48496, volume and number of this NASA Tech Briefs issue*, and the page number.*

Practical UAV Optical Sensor Bench With Minimal Adjustability

Goddard Space Flight Center, Greenbelt, Maryland

A multiple-pass optical platform eliminates essentially all optical alignment degrees of freedom, save one. A four-pass absorption spectrometer architecture is made rigid by firmly mounting dielectric-coated mirror prisms with no alignment capability to the platform. The laser diode beam is collimated by a small, custom-developed lens, which has only a rotational degree of freedom along the standard optical "z" axis. This degree is itself eliminated by adhesive after laser collimation. Only one degree of freedom is preserved by allowing the laser diode chip and mount subassembly to move relative to the collimating lens by using over-sized mounting holes. This allows full 360° motion of a few millimeters relative to the lens, which, due to the high numerical aperture of the lens, provides wide directional steering of the collimated laser beam.

Because the optical layout has been designed to provide proper mirror alignment for an orthonormal, paraxial laser beam, this degree of freedom is sufficient to insure perfect optical alignment once the orthonormal condition is satisfied. Further, the degree of freedom is enabled by using either simple loose metal screws in the over-sized laser mounting holes, plastic screws with low tension, or a combination of the two. Once alignment is achieved, the screws are tightened sufficiently to insure ruggedness, or the plastic screws may be replaced, one by one, with metal screws. In either case, even the remaining degree of freedom is locked down after the final alignment. The final degree of freedom may be permanently, or quasi-permanently, locked by use of various adhesives on the screw head or threads.

This work was done by Jeffrey Pilgrim and Paula Gonzales of Vista Photonics, Inc. for Goddard Space Flight Center. Further information is contained in a TSP (see page 1). GSC-16536-1