Pointing Reference Scheme for Free-Space Optical Communications Systems

A technique is proposed for referencing infrared transmit lasers with silicon detectors.

NASA’s Jet Propulsion Laboratory, Pasadena, California

A scheme is proposed for referencing the propagation direction of the transmit laser signal in pointing a free-space optical communications terminal. This recently developed scheme enables the use of low-cost, commercial silicon-based sensors for tracking the direction of the transmit laser, regardless of the transmit wavelength. Compared with previous methods, the scheme offers some advantages of less mechanical and optical complexity and avoids expensive and exotic sensor technologies.

In free-space optical communications, the transmit beam must be accurately pointed toward the receiver in order to maintain the communication link. The current approaches to achieve this function call for part of the transmit beam to be split off and projected onto an optical sensor used to infer the pointed direction. This requires that the optical sensor be sensitive to the wavelength of the transmit laser. If a different transmit wavelength is desired, for example to obtain a source capable of higher data rates, this can become quite impractical because of the unavailability or inefficiency of sensors at these wavelengths. The innovation proposed here decouples this requirement by allowing any transmit wavelength to be used with any sensor.

We have applied this idea to a particular system that transmits at the standard wavelength of 1.550 nm, which is a standard wavelength for long-haul fiber-optic communication systems. The spectral width of this microwave signal was less than 200 Hz. The threshold pump power for generating the microwave signal was about 1 mW. It would be possible to reduce the threshold power by several orders of magnitude if resonators could be made from crystalline materials in dimensions comparable to those of microresonators heretofore made from fused silica.

This work was done by Lute Maleki, Andrei Matsko, Anatoliy Savchenkov, and Dmitry Strekalov of Caltech for NASA’s Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1).

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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An Example Implementation is shown of the much simpler pointing reference scheme.
High-Level Performance Modeling of SAR Systems

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SAUSAGE (Still Another Utility for SAR Analysis that's General and Extensible) is a computer program for modeling (see figure) the performance of synthetic-aperture radar (SAR) or interferometric synthetic-aperture radar (InSAR or IFSAR) systems. The user is assumed to be familiar with the basic principles of SAR imaging and interferometry. Given design parameters (e.g., altitude, power, and bandwidth) that characterize a radar system, the software predicts various performance metrics (e.g., signal-to-noise ratio and resolution). SAUSAGE is intended to be a general software tool for quick, high-level evaluation of radar designs; it is not meant to capture all the subtleties, nuances, and particulars of specific systems. SAUSAGE was written to facilitate the exploration of engineering tradeoffs within the multidimensional space of design parameters. Typically, this space is examined through an iterative process of adjusting the values of the design parameters and examining the effects of the adjustments on the overall performance of the system at each iteration. The software is designed to be modular and extensible to enable consideration of a variety of operating modes and antenna beam patterns, including, for example, strip-map and spotlight SAR acquisitions, polarimetry, burst modes, and squinted geometries.

This program was written by Curtis Chen of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1).

This work was done by Malcolm Wright, Gerardo Ortiz, and Muthu Jeganathan of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1).

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