Programmable Pulse-Position-Modulation Encoder

NASA's Jet Propulsion Laboratory, Pasadena, California

A programmable pulse-position-modulation (PPM) encoder has been designed for use in testing an optical communication link. The encoder includes a programmable state machine and an electronic code book that can be updated to accommodate different PPM coding schemes. The encoder includes a field-programmable gate array (FPGA) that is programmed to step through the stored state machine and code book and that drives a custom high-speed serializer circuit board that is capable of generating subnanosecond pulses. The stored state machine and code book can be updated by means of a simple text interface through the serial port of a personal computer.

This work was done by David Zhu and William Farr 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:

Innovative Technology Assets Management
JPL
Mail Stop 202-233
4800 Oak Grove Drive
Pasadena, CA 91109-8099
(818) 354-2240
E-mail: iaoffice@jpl.nasa.gov

Refer to NPO-41103, volume and number of this NASA Tech Briefs *issue, and the page number.*

Wavelength-Agile External-Cavity Diode Laser for DWDM

Lyndon B. Johnson Space Center, Houston, Texas

A prototype external-cavity diode laser (ECDL) has been developed for communication systems utilizing dense wavelength-division multiplexing (DWDM). This ECDL is an updated version of the ECDL reported in "Wavelength-Agile External-Cavity Diode Laser" (LEW-17090), *NASA Tech Briefs*, Vol. 25, No. 11 (November 2001), page 14a. To recapitulate: The wavelength-agile ECDL combines the stability of an external-cavity laser with the wavelength agility of a diode laser. Wavelength is modulated by modulating the injection current of the diode-laser gain element. The external cavity is a Littman-Metcalf resonator, in which the zeroth-order output from a diffraction grating is used as the laser output and the first-order-diffracted light is retroreflected by a cavity feedback mirror, which establishes one end of the resonator. The other end of the resonator is the output surface of a Fabry-Perot resonator that constitutes the diode-laser gain element. Wavelength is selected by choosing the angle of the diffracted return beam, as determined by position of the feedback mirror. The present wavelength-agile ECDL is distinguished by design details that enable coverage of all 60 channels, separated by 100-GHz frequency intervals, that are specified in DWDM standards.

This work was done by Jeffrey S. Pilgrim and David S. Bomse of Southwest Sciences, Inc., for **Johnson Space Center**.

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:

Southwest Sciences, Inc.
1570 Pacheco Street: Suite E-11
Santa Fe, NM 87505

Refer to MSC-23408, volume and number of this NASA Tech Briefs *issue, and the page number.*

Pattern-Recognition Processor Using Holographic Photopolymer

This processor would operate in real time with high resolution.

NASA's Jet Propulsion Laboratory, Pasadena, California

A proposed joint-transform optical correlator (JTOC) would be capable of operating as a real-time pattern-recognition processor. The key correlation-filter reading/writing medium of this JTOC would be an updateable holographic photopolymer. The high-resolution, high-speed characteristics of this photopolymer would enable pattern-recognition processing to occur at a speed three orders of magnitude greater than that of state-of-the-art digital pattern-recognition processors. There are many potential applications in biometric personal identification (e.g., using images of fingerprints and faces) and nondestructive industrial inspection.

In order to appreciate the advantages of the proposed JTOC, it is necessary to understand the principle of operation of a conventional JTOC. In a conventional JTOC (shown in the upper part of the figure), a collimated laser beam passes through two side-by-side spatial light modulators (SLMs). One SLM displays a real-time input image to be recognized. The other SLM displays a reference image from a digital memory. A Fourier-transform lens is placed at its focal distance from the SLM plane, and a charge-coupled device (CCD) image detector is placed at the back focal plane of the lens for use as a square-law recorder.

Processing takes place in two stages. In the first stage, the CCD records the interference pattern between the Fourier transforms of the input and reference images, and the pattern is then digitized and saved in a buffer memory. In the second stage, the reference SLM is turned off and the interference pattern is fed back to the input SLM. The interference pattern thus becomes Fourier-transformed, yielding at the CCD an image representing the joint-transform correlation between the input and reference images. This image con-