

gion — about 21 nm wide in wavelength and 6.3 THz wide in frequency — would feature an edge-to-edge phase change of 2.08 full cycles — slightly greater than 4 radians. The large edge-to-edge phase change would create the potential for any level of phase modulation, provided that one could select a modulation technique that would shift the transmission function far enough in the appropriate direction.

Computational tests were performed for an input optical signal with a Gaussian amplitude envelope, a center wavelength of 993.3 nm, and a root-mean-square (rms) wavelength width of 5 nm, corresponding to pulse duration of 52 fs. One reason for this choice of parameters is that it positions the rms bandwidth of the signal within the shorter-wavelength half of the transmission pass band of the device with the center wavelength at the peak of the second transmission resonance ripple. Another reason for this choice of parameters is that it provides for all significant frequency components

of the signal to have access to a full cycle of phase modulation without adversely affecting transmission levels.

An appropriate modulation technique would enable the wavelength shift of the transmission function such that the signal would be shifted from lower half of the pass band to the upper half of the pass band; this amount of shift would bring all significant frequency components of the signal through a complete cycle of phase modulation. In order for this modulation scheme to be successful, the wavelength shift of the transmission must not change the shape of this function in the pass band. The fabricated prototype device has been characterized in its ability to affect transmission phase through a mechanical change in the signal's angle of incidence.

Nonmechanical modulation would likely be effected by an electrorefractive or nonlinear optical technique that would vary the indices of refraction of the GaAs and AlAs layers. The technique has not yet been selected. A computational simula-

tion has shown that a decrease of 1.3 percent in the indices of refraction of the GaAs and AlAs layers would shift the transmission function to shorter wavelengths by an amount sufficient to provide a full cycle of phase modulation for the 993.3-nm test signal. The simulation also showed that a similarly sized increase in the indices of refraction would shift the transmission function to longer wavelengths by an amount sufficient to put the test signal in a wavelength region of high reflectivity; taking advantage of this behavior, one could use the device as an optical switch.

*This work was done by Andrew Scott Keys of Marshall Space Flight Center and Richard Lynn Fork of the University of Alabama in Huntsville. Further information is contained in a TSP (see page 1).*

*This invention is owned by NASA, and a patent application has been filed. For further information, contact Jim Dowdy, MSFC Commercialization Assistance Lead, at [jim.dowdy@nasa.gov](mailto:jim.dowdy@nasa.gov). Refer to MFS-31565.*

## Second-Generation Multi-Angle Imaging Spectroradiometer

NASA's Jet Propulsion Laboratory, Pasadena, California

A report discusses an early phase in the development of the MISR-2 C, a second, improved version of the Multi-angle Imaging SpectroRadiometer (MISR), which has been in orbit around the Earth aboard NASA's Terra spacecraft since 1999. Like the MISR, the MISR-2 would contain a "pushbroom" array of nine charge-coupled-device (CCD) cameras — one aimed at the nadir and the others aimed at different angles sideways from the nadir. The major improvements embodied in the MISR-2 would be the following:

- A new folded-reflective-optics design would render the MISR-2 only a third as massive as the MISR.
  - Smaller filters and electronic circuits would enable a reduction in volume to a sixth of that of the MISR.
  - The MISR-2 would generate images in two infrared spectral bands in addition to the blue, green, red, and near-infrared spectral bands of the MISR.
  - Miniature polarization filters would be incorporated to add a polarization-sensing capability.
  - Calibration would be performed non-intrusively by use of a gimbaled tenth camera.
- The main accomplishment thus far has been the construction of an extremely compact all-reflective-optics CCD camera to demonstrate feasibility.

*This work was done by Steven Macenka, Larry Hovland, Daniel Preston, Brian Zellers, and Kevin Downing of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). NPO-35097*