above. In the range-finding mode, the laser diode(s) would be toggled between two programmed power levels, while the intensities of the outgoing and return laser beams would be sensed by two matched photodetectors. The outputs of the photodetectors would be sent to dedicated high-speed analog-to-digital converters, the outputs of which would be stored (buffered) for processing.

The DSP would execute algorithms that would determine the time between corresponding transitions of the outgoing and return signals and, hence, equivalently, the time of flight of the laser signal and the distance to the target. The algorithms would be modern ones that would enable determination of the time of flight to within a small fraction of the transition time between the two laser power levels, even if the outgoing and return laser waveforms were slow, nonlinear, or noisy. The DSP would also execute an algorithm that would determine the return signal level and would accordingly adjust the laser output and the gain of a programmable-gain amplifier.

This work was done by Thomas Bryan, Richard Howard, Joseph L. Bell, Fred D. Roe, and Michael L. Book of **Marshall Space Flight Center**. *Further information is contained in a TSP (see page 1).*

This invention has been patented by NASA (U.S. Patent No. 7,006,203). Inquiries concerning nonexclusive or exclusive license for its commercial development should be addressed to Sammy Nabors, MSFC Commercialization Assistance Lead, at sammy.a.nabors@nasa.gov. Refer to MFS-31785-1.

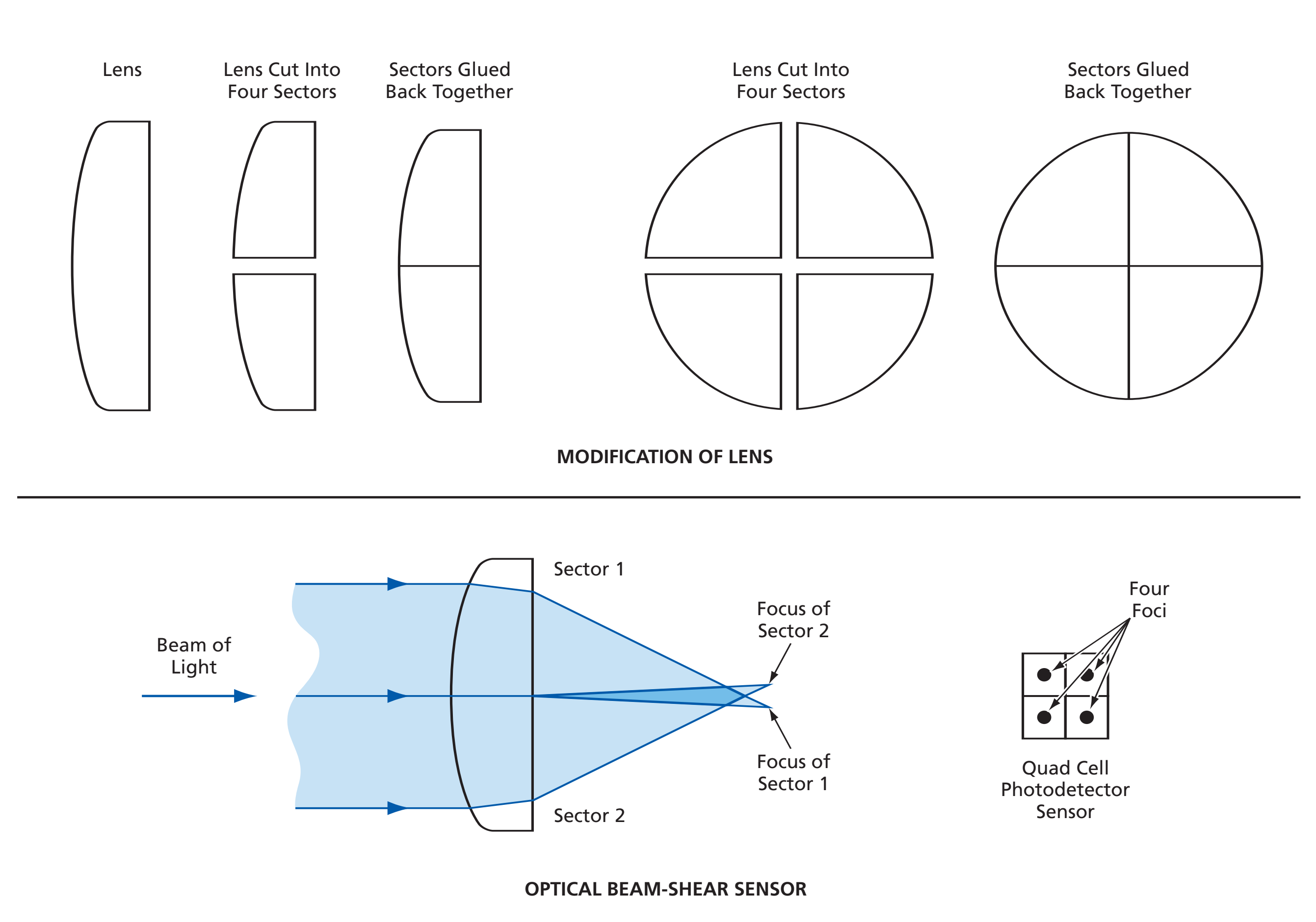
Optical Beam-Shear Sensors

Simple sensors measure radiant fluxes in beam quadrants.

NASA's Jet Propulsion Laboratory, Pasadena, California

A technique for measuring optical beam shear is based on collecting light from the four quadrants of the beam and comparing the optical power collected from each quadrant with that from the other three quadrants. As used here, "shear" signifies lateral displacement of a beam of light from a nominal optical axis.

A sensor for implementing this technique consists of a modified focusing lens and a quad-cell photodetector, both centered on the nominal optical axis. The modification of the lens consists in cutting the lens into four sectors (corresponding to the four quadrants) by sawing along two orthogonal diameters, then reassembling the lens follow-



An **Optical Beam-Shear Sensor** can be made from a lens and a quad-cell photodetector.

ing either of two approaches described next.

In one approach, the lens is reassembled by gluing the sectors back together. In the simplest variant of this approach, the kerf of the saw matches the spacing of the photodetector cells, so that the focus of each sector crosses the axis of symmetry to fall on the opposite photodetector cell (see figure). In another variant of this approach, the lens sectors are spaced apart to make their individual foci to fall on separate photodetector cells, without crossing the optical axis. In the case of a sufficiently wide beam, the modified lens could be replaced with four independent lenses placed in a square array, each focusing onto an independent photodetector.

This work was done by Stefan Martin and Piotr Szwaykowski of Caltech for **NASA's Jet Propulsion Laboratory**. *Further information is contained in a TSP (see page 1).*
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