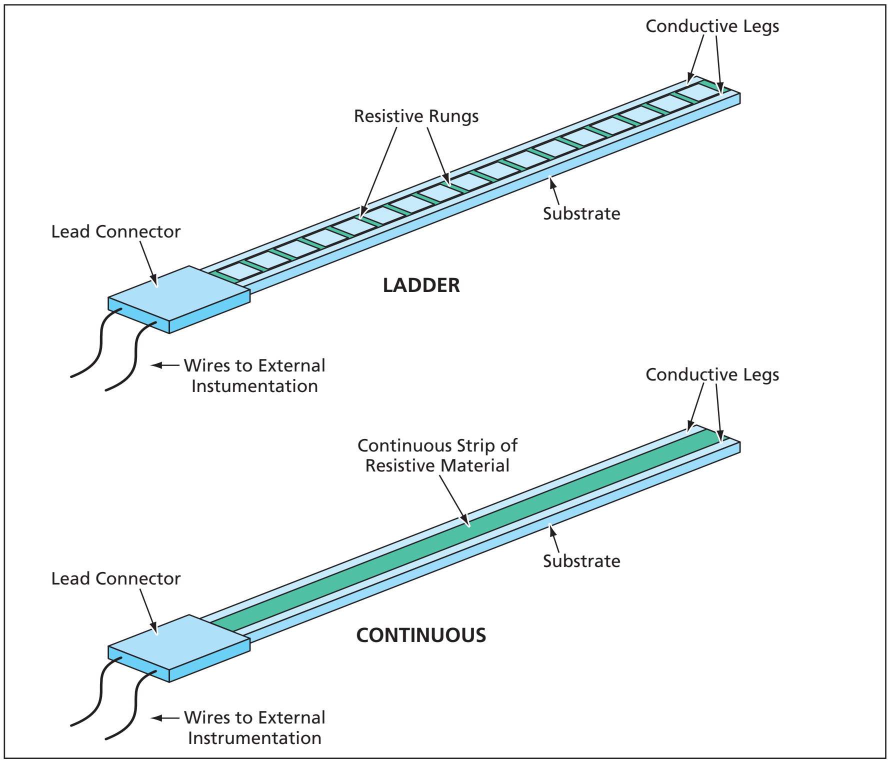
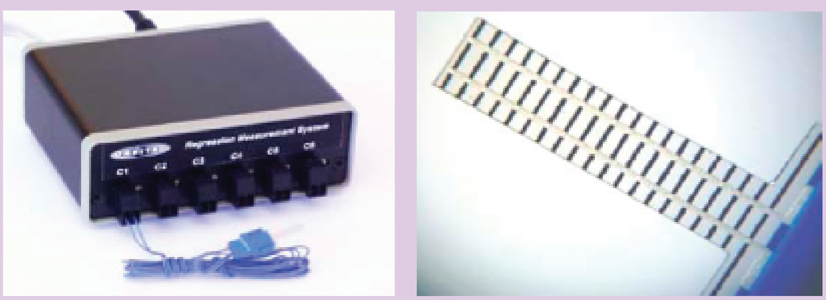


Figure 1. The **Two Baseline MSRS Configurations** offer different features. The ladder configuration gives readings in precise increments of material thickness, while the continuous configuration gives a constant indication of material thickness.



Six-Channel Signal Conditioner MSRS Ladder Sensor

Figure 2. A **Ground-Based MSRS Sensor Package** has been developed that features small size and low mass. Future generations of the MSRS technology could be used to transmit real-time regression rate and material thickness data from a vehicle in flight.

tors can be calculated simply as the distance between the resistors divided by the time interval between their resistance jumps. Advanced data reduction techniques have also been developed to establish the instantaneous surface position and regression rate when the regressing front is between rungs.

A continuous MSRS is so named because instead of discrete rungs, there is one continuous strip of resistive material across the legs. Assuming that this strip has spatially uniform thickness and resistivity and that the electrical resistance of the legs is much less than that of the strip, the electrical resistance of this MSRS is inversely proportional to the remaining length of the sensor and, hence, to the remaining thickness of the host material in which it is embedded.

A ground-based sensor package has been developed (see Figure 2). Due to its small size and low mass potential, future generations of the MSRS technology could be applied to flight applications. One eventual goal is to provide the capability to record and transmit real-time regression data from a vehicle in flight. In this capacity, the sensor could serve a dual-use role by providing engineering data under actual operating conditions, as well as health monitoring of the host material.

This work was done by Daniel J. Gramer, Thomas J. Taagen, and Anton G. Vermaak of Orbital Technologies Corp. for **Stennis 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:

Orbital Technologies Corp. (ORBITEC)
1212 Fourier Dr.
Madison, WI 53717
Phone No.: (608) 827-5000

Refer to SSC-00140, volume and number of this NASA Tech Briefs *issue, and the page number.*

Coordinating an Autonomous Earth-Observing Sensorweb

NASA's Jet Propulsion Laboratory, Pasadena, California

A system of software has been developed to coordinate the operation of an autonomous Earth-observing sensorweb. Sensorwebs are collections of sensor units scattered over large regions to gather data on spatial and temporal patterns of physical, chemical, or biological phenomena in those regions. Each sensor unit is a node in a data-gathering/data-communication network that spans a region of interest. In this case, the region is the entire Earth, and the sensorweb includes multiple terrestrial and spaceborne sensor units. In addition to acquiring data for scientific study, the sensorweb is required to give timely notice of volcanic eruptions, floods, and other hazardous natural events. In keeping with the inherently modular nature of the sensory, communication, and data-processing hardware, the software features a flexible, modular architecture that facilitates expansion of the network, customization of conditions that trigger alarms of hazardous natural events, and customization of responses to alarms. The software facilitates access to multiple sources of data on an event of scientific interest, enables coordinated use of multiple sensors in rapid reaction to detection of an event, and facilitates the tracking of spacecraft operations, including tracking of the acquisition, processing, and downlinking of requested data.

This program was written by Robert Sherwood, Benjamin Cichy, Daniel Tran, Steve Chien, Gregg Rabideau, Ashley Davies, Rebecca Castaño, Stuart Frye, Dan Mandl, Seth Shulman, and Sandy Grosvenor of Caltech for **NASA's Jet Propulsion Laboratory**. *Further information is contained in a TSP (see page 1).*

This software is available for commercial licensing. Please contact Karina Edmonds of the California Institute of Technology at (626) 395-2322. Refer to NPO-42523.

Range-Measuring Video Sensors

Distances would be measured by three-dimensional triangulation.

Marshall Space Flight Center, Alabama

Optoelectronic sensors of a proposed type would perform the functions of both electronic cameras and triangulation-type laser range finders. That is to say, these sensors would both (1) generate ordinary video or snapshot digital images and (2) measure the distances to selected spots in the images. These sensors would be well suited to use on robots that are required to measure distances to targets in their work spaces. In addition, these sensors could be used for all the purposes for which electronic cameras have been used heretofore.

The simplest sensor of this type, illustrated schematically in the upper part of the figure, would include a laser, an electronic camera (either video or snapshot), a frame-grabber/image-capturing circuit, an image-data-storage memory circuit, and an image-data processor. There would be no moving parts. The laser would be positioned at a lateral distance d to one side of the camera and would be aimed parallel to the optical axis of the camera. When the range of a target in the field of view of the camera was required, the laser would be turned on and an image of the target would be stored and preprocessed to locate the angle (α) between the optical axis and the line of sight to the centroid of the laser spot. Then the range, r (more precisely, the length of the optical-axis component of the range vector) of the laser-illuminated spot on the target would be given by

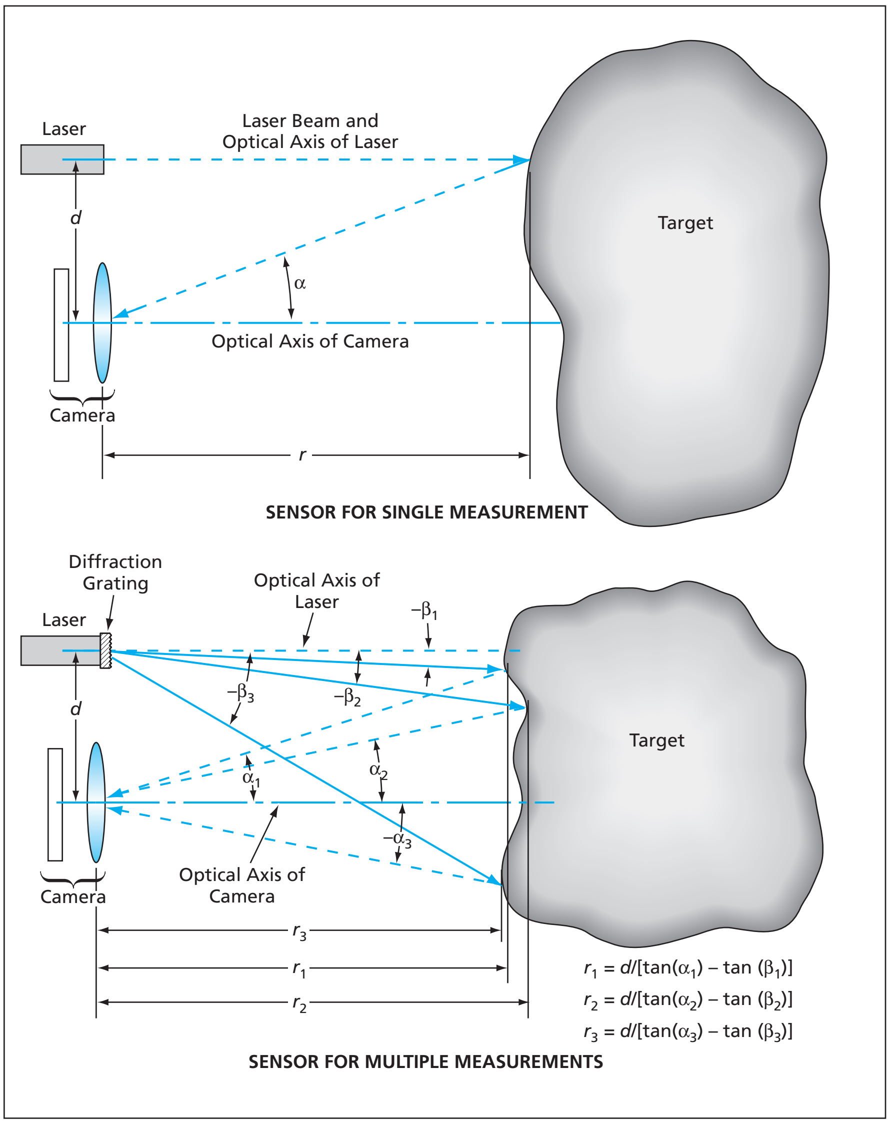
$$r = d/\tan(\alpha).$$

The lower part of the figure depicts a more complex sensor that could measure the ranges of multiple targets or multiple spots on the same target. The basic optical arrangement would be as described above, except that a diffraction grating would split the laser beam into multiple beams, each at a different angle in the plane defined by the camera and laser optical axes. In this case, the range of the spot illuminated by the ith laser beam would be given by

$$r_i = d/[\tan(\alpha_i) - \tan(\beta_i)],$$

where β_i is the angle of the ith beam and all angles are measured as positive above or negative below the horizontal optical axes in the figure.

This work was done by Richard T. Howard, Jeri M. Briscoe, Eric L. Corder, and David Broderick of **Marshall Space Flight Center**. *Further information is contained in a TSP (see page 1). MFS-31891-1*



These **Two Sensors** would utilize triangulation to measure ranges. The simpler sensor is shown at the top, mainly to help explain the basic principle of operation. The more complex sensor shown at the bottom would likely be preferable in practice.