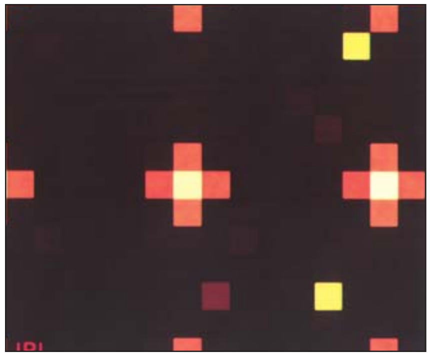
taining detailed information pertaining to all the pixels. Unlike the prior methods, this method does not require flat-field illumination of the array: indeed, the method does not require any illumination.

The method involves a sequence of resets of subarrays of pixels to specified voltages and measurement of the voltage responses of neighboring non-reset pixels. The spacing of the reset pixels is chosen in accordance with the number of neighboring pixels over which the coupling coefficients are sought. The sequence begins with reset of all the pixels in the array to a specified first voltage level. In the next step, a subarray of pixels is reset to a specified second voltage level. Signals consisting of portions of the second reset voltage change are coupled capacitively from the pixels of the reset subarray to adjacent non-second-reset pixels. These signals can be mapped in the form of difference images from the pixel voltages measured immediately before and immediately after the second reset (see figure). The sequence as described thus far can be repeated for different subarrays of pixels, as needed, to acquire data for characterizing all pixels of interest. The entire sequence can be repeated to acquire multiple sets of data that can be combined to reduce measurement noise.



This **Difference Image** from a portion of an image detector containing a rectangular pixel array was generated from two images: one recorded immediately after and one recorded immediately before the second reset. The second-reset pixels were those residing at intersections of rows and columns at seven-pixel intervals.

This work was done by Suresh Seshadri, David M. Cole, and Roger M. Smith of Caltech for NASA's Jet Propulsion Laboratory.

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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Refer to NPO-45223, volume and number of this NASA Tech Briefs *issue, and the page number.*

Fiber-Based Laser Transmitter for Oxygen A-Band Spectroscopy and Remote Sensing

Goddard Space Flight Center, Greenbelt, Maryland

A fiber-based laser transmitter has been designed for active remote-sensing spectroscopy. The transmitter uses a master-oscillator-power-amplifier (MOPA) configuration with a distributed feedback diode-laser master oscillator and an erbium-doped fiber amplifier. The output from the MOPA is frequency-doubled with a periodically poled nonlinear crystal. The utility of this single-frequency, wavelength-tunable, power-scalable laser has been demonstrated in a spectroscopic measurement of the diatomic oxygen A-band.

The problem that needed to be addressed was how to measure atmospheric state parameters (like temperature and pressure) from space to get local measurements and global coverage. The only successful laser transmitter that had been used for this type of measurement (remote sensing from an airplane) used dye and alexandrite lasers. These devices were both spectroscopically and mechanically unstable and very inefficient. This transmitter design offers many advantages over this technology.

Fiber-based technology vastly improves mechanical alignment issues because optical path is inside a waveguide that is spliced together and no longer contingent on the relative alignment of bulk optical parts. Many of the components are built to telecommunications industry reliability standards.

This work was done by Mark A. Stephen and James B. Abshire of Goddard Space Flight Center. For further information, contact the Goddard Innovative Partnerships Office at (301) 286-5810. GSC-15710-1

Low-Profile, Dual-Wavelength, Dual-Polarized Antenna

This antenna system has uses in remote monitoring of ocean storms and in search and rescue operations.

Goddard Space Flight Center, Greenbelt, Maryland

A single-aperture, low-profile antenna design has been developed that supports dual-polarization and simultaneous operation at two wavelengths. It realizes multiple beams in the elevation plane, and supports radiometric, radar, and conical scanning applications.

This antenna consists of multiple azimuth sticks, with each stick being a multilayer, hybrid design. Each stick forms the h-plane pattern of the C and Ku-band vertically and horizontally polarized antenna beams. By combining several azimuth sticks together, the elevation beam is formed. With a separate transceiver for each stick, the transmit phase and amplitude of each stick can be controlled to synthesize a beam at a specific incidence angle and to realize a particular side-lobe pattern. By changing the transmit phase distribution through the transceivers, the transmit antenna beam can be steered to different incidence angles. By controlling the amplitude distribution, different sidelobe patterns and efficiencies can be realized. The receive beams are formed using digital beam synthesis techniques, resulting in very little loss in the receive path, thus enabling a very-low-loss receive antenna to support passive measurements.

Each azimuth stick consists of a dual-polarized Ku-band slotted waveguide linear array that is one-half of a Ku-band wavelength wide and is center-fed. The latter ensures that grating lobes will not be produced in the full array. The linear array has two sections, one supporting broadside slots and the other "edge" slots. For the broadside slots, a ridge waveguide is used to reduce the width of the waveguide section well below one-half wavelength.

For the initial instrument design, the full array will implement phase steering to form the transmit beam and digital beam synthesis to form the receive beam. The phase and amplitude of the transmit signal delivered to each vertically and horizontally polarized C and Ku-band port on the array will be controlled through dedicated, phase-locked transceivers. The array will be conically scanned to map a large surface swath beneath the aircraft and provide multiple looks at each along and cross track pixel within the swath. This will permit ocean vector wind scatterometry techniques to be applied. The coincident passive measurements obtained with this antenna will allow the atmospheric attenuation to be estimated and used to aid the ocean vector wind retrieval process, especially in the presence of precipitation where the Ku-band receive signals will be attenuated.

This antenna's compact design will reduce deployment costs for ground-based applications, and will be ideal for mobile applications where space is often limited. Its ability to separate transmit and receive modes permits very low losses to be achieved during the receive phase, allowing for coincident active and passive measurements. Its flexibility to support frequency, phase, and digital beam synthesis techniques allows it to service a broad market, and its scalability will enable it to be customized to commercial applications at very little cost.

This system has application in monitoring the ocean surface vector wind in tropical cyclones and other severe ocean storms. In defense applications, it has uses where an imaging and mapping dual-band, dual-polarized antenna would provide strategic advantages. Search and rescue missions also can benefit from this antenna technology.

This work was done by James R. Carswell of Remote Sensing Solutions, Inc. for Goddard Space Flight Center. Further information is contained in a TSP (see page 1). GSC-15706-1

Time-Separating Heating and Sensor Functions of Thermistors in Precision Thermal Control Applications

This technology can be applied to telescope sensor and optics uses.

NASA's Jet Propulsion Laboratory, Pasadena, California

A method allows combining the functions of a heater and a thermometer in a single device, a thermistor, with minimal temperature read errors. Because thermistors typically have a much smaller thermal mass than the objects they monitor, the thermal time to equilibrate the thermometer to the temperature of the object (τ_t) is typically much shorter than the thermal time of the object to change its temperature in response to an external perturbation (τ_O), $\tau_t << \tau_O$.

It is possible to switch the heater controlling the object's temperature off for this shorter length of time. While the heater is switched off, the thermistor is allowed the time equal to several τ_t to reach equilibrium with the object, then its temperature is measured, after which the heater is turned back on. The measured value is provided for any temperature control, and the voltage on the thermistor during the heating potion of the cycle will be determined by that control.

In one tested implementation, the τ_t was measured to be under 0.5 ms, and $\tau_O \approx 2$ s. In the timing sequence in this implementation, the heater circuit is turned off, and the measurement current is turned on. After ≈3 ms, the voltage readout is accomplished in ≈1 ms. A fraction of ms later, the heater is turned back on for ≈95 ms.

In one embodiment of this solution, a sample and hold circuit captures the voltage (resistance) readout during the short measurement interval and provides the capture value for the duration of the cycle. This embodiment can be used with any temperature controller, including off-the-shelf PID controllers.

Another embodiment involves a readout that is synchronized with the multiplexed readout of one sensor in a collection, and the heater is connected to the same sensor while the multiplexer is reading other sensors. This solution requires a PID circuit compatible with the multiplexed readout, typically implemented in an FPGA solution with a clock-driven timing.

This work was done by Hyung J. Cho, Kalyani G. Sukhatme, John C. Mahoney, Konstantin Penanen, and Rudolph Vargas, Jr., of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). NPO-46900