

the QWIP-array/readout-multiplexer is nearly identical to that of the prior camera. An important difference is that in the present camera, the readout multiplexer is part of a commercial infrared-camera body that includes two “back-end” video-signal-processing circuits and a germanium lens of 100-mm focal length and 5.5° field of view. The lens is designed to be transparent in the wavelength range of 7 to 14 μm (compatible with a nominal QWIP operational wavelength of 8.5 μm). The digital acquisition resolution of the camera circuitry is 14 bits, so that the instantaneous dynamic range of the cam-

era is 16,384. However, the dynamic range of the QWIPs is 85 dB.

The camera has been demonstrated to produce excellent video imagery (see figure). Whereas prior infrared cameras based on detectors of different types have been limited to thermal resolutions in excess of 30 mK, this camera is expected to exhibit significantly finer thermal resolution: On the basis of single-pixel test data, a noise equivalent differential temperature of 8 mK is expected in operation at a temperature of 65 K with $f/2$ (focal length \div aperture diameter = 2) optics and a background temperature of 300 K. The

array of photodetectors has exhibited background-limited performance at an operating temperature of 72 K using the same optics and background conditions. Optimization of operating conditions (including frame rate, integration time, and QWIP bias voltage) is expected to lead to even better performance.

This work was done by Sarath Gunapala, Sumith Bandara, John Liu, and Sir B. Rafol of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). NPO-30624

An Array of Optical Receivers for Deep-Space Communications

This array would be considerably simpler and less expensive to implement.

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An array of small optical receivers is proposed as an alternative to a single large optical receiver for high-data-rate communications in NASA's Deep Space Network (DSN). Because the telescope for a single receiver capable of satisfying DSN requirements must be greater than 10 m in diameter, the design, building, and testing of the telescope would be very difficult and expensive. The proposed array would utilize commercially available telescopes of 1-m or smaller diameter and, therefore, could be developed and verified with considerably less difficulty and expense.

The essential difference between a single-aperture optical-communications receiver and an optical-array receiver is that a single-aperture receiver focuses all of the light energy it collects onto the surface of an optical detector, whereas an array receiver focuses portions of the total collected energy onto separate detectors, optically detects each fractional energy component, then combines the electrical signal from the array of detector outputs to form the observable, or “decision statistic,” used to decode the transmitted data.

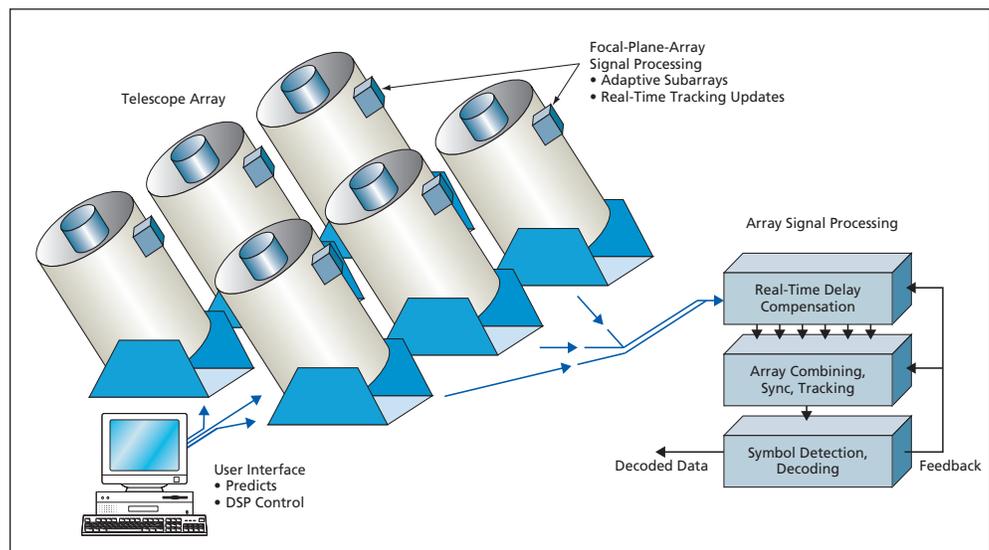
A conceptual block diagram identifying the key components of the optical-array receiver suitable for deep-space telemetry reception is shown in the figure. The most conspicuous feature of the receiver is the large number of small- to medium-size telescopes, with individual apertures and

number of telescopes selected to make up the desired total collecting area. This array of telescopes is envisioned to be fully computer-controlled via the user interface and prediction-driven to achieve rough pointing and tracking of the desired spacecraft. Fine-pointing and tracking functions then take over to keep each telescope pointed toward the source, despite imperfect pointing predictions, telescope-drive errors, and vibration caused by wind.

The turbulence-degraded image of the laser source in each telescope would be sensed by a focal-plane photodetector array, the outputs of which would then be digitized. The digitized array outputs would be synchronized and combined by field-programmable gate-

array circuits that would execute digital-signal-processing algorithms, for both the individual telescopes and the entire array. Symbol detection and decoding operations would then be carried out on the synchronized and combined array signal. Receiver parameters would be controlled adaptively at each telescope to accommodate changing atmospheric conditions, thus optimizing the performance of the optical-array receiver in real time.

This work was done by Victor Vilnrotter, Chi-Wung Lau, Meera Srinivasan, Kenneth Andreus, and Ryan Mukai of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). NPO-40190



A Conceptual Block Diagram of the Optical-Array Receiver identifies key receiver functions.