electronics, makes single-mode output possible. In this case, the system continously monitors the cavity length and isolates a single longitudinal mode as the wavelength is scanned. In both cases, the MOPO design apparently achieves an overall conversion efficiency exceeding 20%.

Extending the wavelength range below 400 nm will require frequency doubling of the OPO output. Based on results from existing R&D systems, Sobey says S-PL engineers expect to achieve a frequency-doubling conversion efficiency exceeding 15% when covering the 200–400-nm range. He also says that existing OPO products have been designed with doubling in mind, so they will be able to accommodate a doubling stage when it becomes available. At the longer end of the wavelength range, an additional set of optics will eventually enable the existing products to tune from 2000 to 3000 nm.

Stephen G. Anderson

DETECTOR ELECTRONICS

IR readout electronics capture focal-plane-array signals

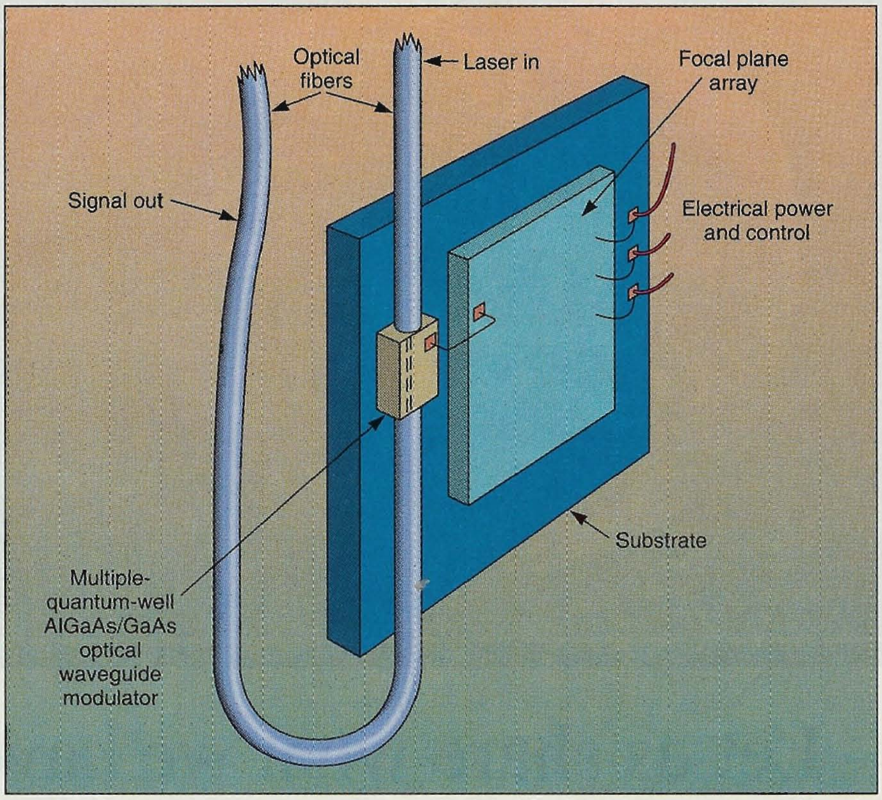
Improvements in detector electronic readout systems parallel advances in focal-plane-array detector systems. The SPIE Aerospace and Remote Sensing Symposium, to be held in Orlando, FL, 12–16 April 1993, includes a session devoted to readouts and signal processing: "Infrared detectors and instrumentation." Highlights of four conference papers are described here by Eric R. Fossum, a research technologist in the Imaging Systems Section at the Jet Propulsion Laboratory, Pasadena, CA 91109.

One active area of research in detector electronics centers on implementing cryogenic readout electronics in gallium arsenide (GaAs) materials. GaAs has a lower carrier freeze-out temperature than silicon. The freeze-out of carriers is directly linked to $1/f$ noise in cryogenic circuits. Thus, GaAs-based circuits can potentially operate with lower noise and at lower temperatures than their silicon counterparts.

The development of GaAs field-effect transistors (FETs) for cryogenic readout of discrete, nonmultiplexed detector arrays will be discussed at the aerospace sensing symposium by R. K. Kirschman and J. A. Lipa of Stanford University (Stanford, CA) and M. Omori from Microwave Technology Inc. (Fremont, CA). These small focal-plane arrays (FPAs) would be used on the Gravity Probe B pointing telescope and would operate at 2–3 K. The researchers will report on the evaluation of commercial and foundry GaAs FETs as well as custom GaAs metal semiconductor FETs and circuits operating at cryogenic temperatures.

For larger FPAs, power dissipation is a critical parameter. At higher temperatures, silicon complementary metal-oxide semiconductor (CMOS) circuits can be used in most applications. The development of CMOS-like complementary-heterojunction FETs (CHFETs) fabricated in the GaAs system for very-low-temperature applications will be described by T. J. Cunningham, E. R. Fossum, and S. M. Baier of the Jet Propulsion Laboratory (JPL, Pasadena, CA) and Honeywell (Bloomington, MN). CHFETs contain both p-channel and n-channel transistors, which allow the development of low-power cryogenic focal-plane circuits for space-based astrophysics applications. While the CHFET may resemble the CMOS structure in superficial ways, the lack of a true insulator such as SiO_2 results in a higher gate-leakage current in a CHFET than in CMOS devices. A parametric study of gate-leakage current as a function of both material configuration and geometry will be presented by JPL. A similar study on noise in these circuits will also be described.

For most infrared (IR) detector-readout applications, silicon CMOS is the predominant technology. The use of innovative circuits can improve the performance of the FPA by reducing both temporal and fixed pattern noise. Recent progress in low-power analog circuits for on-focal-plane signal processing will be discussed by B. Pain and others of JPL. Their paper describes work on a background-suppression circuit for long-wavelength IR FPAs that increases effective dynamic range by removing the background pedestal. The circuit also provides offset nonuniformity correction. Other circuits for low-power, high-gain amplifiers and on-chip analog-to-



Wavelength-matched components enable optically linked focal-plane-array detector to drive multiple-quantum-well modulator. Fiber-coupled near-IR laser beam (1.3 or 1.5 μm) carries the modulated signal to a photodetector outside the Dewar. (Drawing courtesy JPL).

digital conversion will be discussed.

Another paper on detector electronics covers the use of FPA readout using an optical link. A. R. Johnston and others of JPL present analytical and experimental investigation of a focal-plane optical link housed in a Dewar (see figure). The optical link reduces total focal-plane power dissipation, increases system noise immunity, and increases reliability. The JPL approach involves locating the optical source outside the Dewar. Optical fibers and on-focal-plane optical modulators provide readout of the detector array to a photodetector outside the Dewar. Both analog and digital approaches are considered. Experimental results using an AlGaAs/GaAs multiple-quantum-well optical modulator and a $LiNbO_3$ modulator are presented, along with a discussion of linearity, dynamic range, and power dissipation.

OPTICAL COMPUTING

Serial optical processor runs stored commands

A proof-of-principle general-purpose serial optical computer, operating at 50 MHz, was recently demonstrated at the University of Colorado Optoelectronic Computing Systems Center (Boulder, CO).[1] The machine uses AT&T Bell Laboratories (Holmdel, NJ) lithium niobate ($LiNbO_3$) directional couplers as switches, which are connected via single-mode optical fiber. This technology might be applied to communications or other fields in which serial approaches have advantages over parallel.

The computer can be compared to some of the first commercial personal computers of the 1980s—such as the Sinclair ZX81, Commodore VIC20, or Tandy TRS80—but, with 128 bytes of internal memory, it has just one-tenth to one-hundredth of the computing power of these machines (see Fig. 1).

The optical computer is based on accurately matching the path lengths of the infrared data pulses that circu-

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