affected resistors into devices of the present type makes it possible to control their resistances electrically over wide ranges, and the lifetimes of electrically variable resistors exceed those of conventional mechanically variable resistors. Another and potentially the most important class of applications is that of resistance-based nonvolatile-memory devices, such as a resistance random access memory (RRAM) described in the immediately following article, "Electrically Variable Resistive Memory Devices" (MFS-32511-1).

This work was done by Shangqing Liu, Nai-Juan Wu, and Alex Ignatiev of the University of Houston for Marshall Space Flight Center. For further information, contact Sammy Nabors, MSFC Commercialization Assistance Lead, at sammy.a.nabors@nasa.gov. Refer to MFS-32512-1.

Two-Dimensional Synthetic-Aperture Radiometer

Aperture synthesis is employed to reduce antenna mass.

Goddard Space Flight Center, Greenbelt, Maryland

A two-dimensional synthetic-aperture radiometer, now undergoing development, serves as a test bed for demonstrating the potential of aperture synthesis for remote sensing of the Earth, particularly for measuring spatial distributions of soil moisture and ocean-surface salinity. The goal is to use the technology for remote sensing aboard a spacecraft in orbit, but the basic principles of design and operation are applicable to remote sensing from aboard an aircraft, and the prototype of the system under development is designed for operation aboard an aircraft.

In aperture synthesis, one utilizes several small antennas in combination with a signal processing in order to obtain resolution that otherwise would require the use of an antenna with a larger aperture (and, hence, potentially more difficult to deploy in space). The principle upon which this system is based is similar to that of Earth-rotation aperture synthesis employed in radio astronomy. In this technology the coherent products (correlations) of signals from pairs of antennas are obtained at different antenna-pair spacings (baselines). The correlation for each baseline yields a sample point in a Fourier transform of the brightness-temperature map of the scene. An image of the scene itself is then reconstructed by inverting the sampled transform.

The predecessor of the present two-dimensional synthetic-aperture radiometer is a one-dimensional one, named the Electrically Scanned Thinned Array Radiometer (ESTAR). Operating in the L band, the ESTAR employs aperture synthesis in the cross-track dimension only, while using a conventional antenna for resolution in the along-track dimension.

The two-dimensional instrument also operates in the L band — to be precise, at a frequency of 1.413 GHz in the frequency band restricted for passive use (no transmission) only. The L band was chosen because (1) the L band represents the long-wavelength end of the remote-sensing spectrum, where the problem of achieving adequate spatial resolution is most critical and (2) imaging airborne instruments that operate in this wavelength range and have adequate spatial resolution are difficult to build and will be needed in future experiments to validate approaches for remote sensing of soil moisture and ocean salinity.

The two-dimensional instrument includes a rectangular array of patch antennas arranged in the form of a cross. The ESTAR uses analog correlation for one dimension, whereas the two-dimensional instrument uses digital correlation. In two dimensions, many more correlation pairs are needed and low-power digital correlators suitable for application in spaceborne remote sensing will help enable this technology. The two-dimensional instrument is dual-polarized and, with modification, capable of operating in a polarimetric mode. A flight test of the instrument took place in June 2003 and it participated in soil moisture experiments during the summers of 2003 and 2004.

This work was done by David M. Le Vine of Goddard Space Flight Center. Further information is contained in a TSP (see page 1). GSC-14809-1

Ethernet-Enabled Power and Communication Module for Embedded Processors

This device enables serial-to-Ethernet conversion and provides power to remote locations without adding cables.

John F. Kennedy Space Center, Florida

The power and communications module is a printed circuit board (PCB) that has the capability of providing power to an embedded processor and converting Ethernet packets into serial data to transfer to the processor. The purpose of the new design is to address the shortcomings of previous designs, including limited bandwidth and program memory, lack of control over packet processing, and lack of support for timing synchronization.

The module includes an RJ-45 with integrated magnetics and power pass-through, integrated Power over Ethernet (PoE) controller, an Ethernet controller [media access controller (MAC)], a Silicon Laboratories C8051F120 microcontroller with synchronous and asynchronous communication ports, a real-time clock, a hardware watchdog timer, a DC-DC converter with triple output, and 1 Mbit of non-volatile ferroelectric RAM. This new kind of RAM, called FRAM,