dards for direct measurements are provided by the probe manufacturer on an impedance standard substrate. Calibrated probes are then put in contact with the input terminals of the slot-line feed of the antenna, and the antenna is excited via the probes. The direct on-substrate measurement technique is best suited for designs in which the slot-line feeds are short enough to interfere only minimally with the probes.

Figure 2 depicts a setup for measuring the absolute gain of a pair of identical antennas. In this case, the antenna input and output measurements are made by the direct on-substrate probe measurement technique, the antennas are oriented facing each other and matched in polarization, and the antennas are placed far enough apart that, to a close approximation, far-field radiation conditions prevail. The gain is calculated from the geometric parameters of the setup, and from the transmitted and received power levels measured by the ANA via the probes connected to the terminals of the transmitting and receiving antennas, respectively.

This work was done by Rainee Simons of NYMA/Federal Data Corp. and Richard Q. Lee of **Glenn Research Center**. *Further information is contained in a TSP (see page 1).*

Inquiries concerning rights for the commercial use of this invention should be addressed to NASA Glenn Research Center, Commercial Technology Office, Attn: Steve Fedor, Mail Stop 4–8, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-17040.

Cylindrical Antenna With Partly Adaptive Phased-Array Feed

The cost of a high-performance antenna could be reduced.

NASA's Jet Propulsion Laboratory, Pasadena, California

A proposed design for a phased-array-fed cylindrical-reflector microwave antenna would enable enhancement of the radiation pattern through partially adaptive amplitude and phase control of its edge radiating feed elements. Antennas based on this design concept would be attractive for use in radar (especially synthetic-aperture radar) and other systems that could exploit electronic directional scanning and in which there are requirements for specially shaped radiation patterns, including ones with low side lobes. One notable advantage of this design concept is that the transmitter/receiver modules feeding all the elements except the edge ones could be identical and, as a result, the antenna would cost less than in the cases of prior design concepts in which these elements may not be identical.

The basic antenna geometry (see figure) is that of a parabolic cylindrical reflector. The cylindrical axis is the y axis, and the geometric boresight axis is the z axis. The phased array of feed elements lies on the focal line, which is parallel to the y axis, at a distance F from the apex of the parabola. The boundary of the reflector and thus of the aperture, as projected onto the x,y plane, is specified by the superquadric curve

$$\left|\frac{x}{a}\right|^m + \left|\frac{y}{b}\right|^m = 1$$

where a and b are the lengths of the x and y semiaxes, respectively, of the aperture; and m is a parameter that can be chosen to control the rounded shape of the corners. These basic geometric characteristics are the same as those of the antenna described in "Low-Sidelobe Phased-Array-Fed Cylindrical-Reflector Antenna (NPO-20494), *NASA Tech Briefs*, Vol. 24, No. 2 (February 2000), page 5a.

For the non-edge radiating elements, the amplitudes may be chosen to obtain suitably shaped main and side lobes, and the phase difference between adjacent elements would be set at the value needed to point the main lobe in the desired direction. For the nth non-edge element, the excitation coefficient would be of the form

$$a_n e^{jn\alpha},$$

where a_n is the magnitude of the excitation, and α is the progressive phase

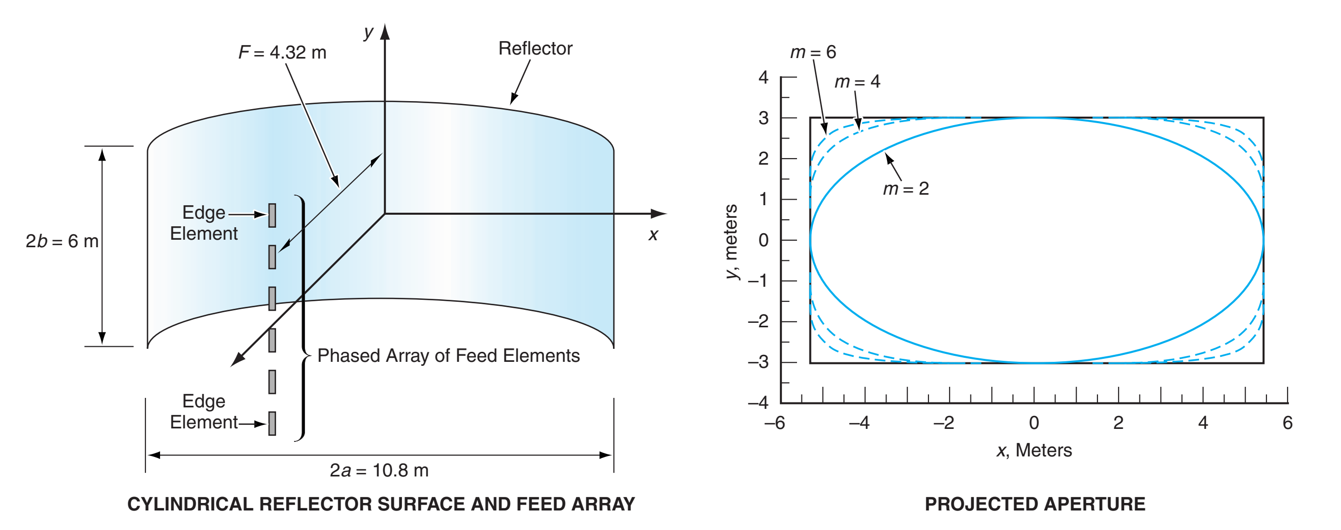

Figure 1. In an **Antenna With a Phased-Array Feed and a Parabolic Cylindrical Reflector** the amplitudes and phases of excitation of the edge elements can be chosen differently from those of the other radiating elements to reduce or cancel side lobes of the radiation pattern.

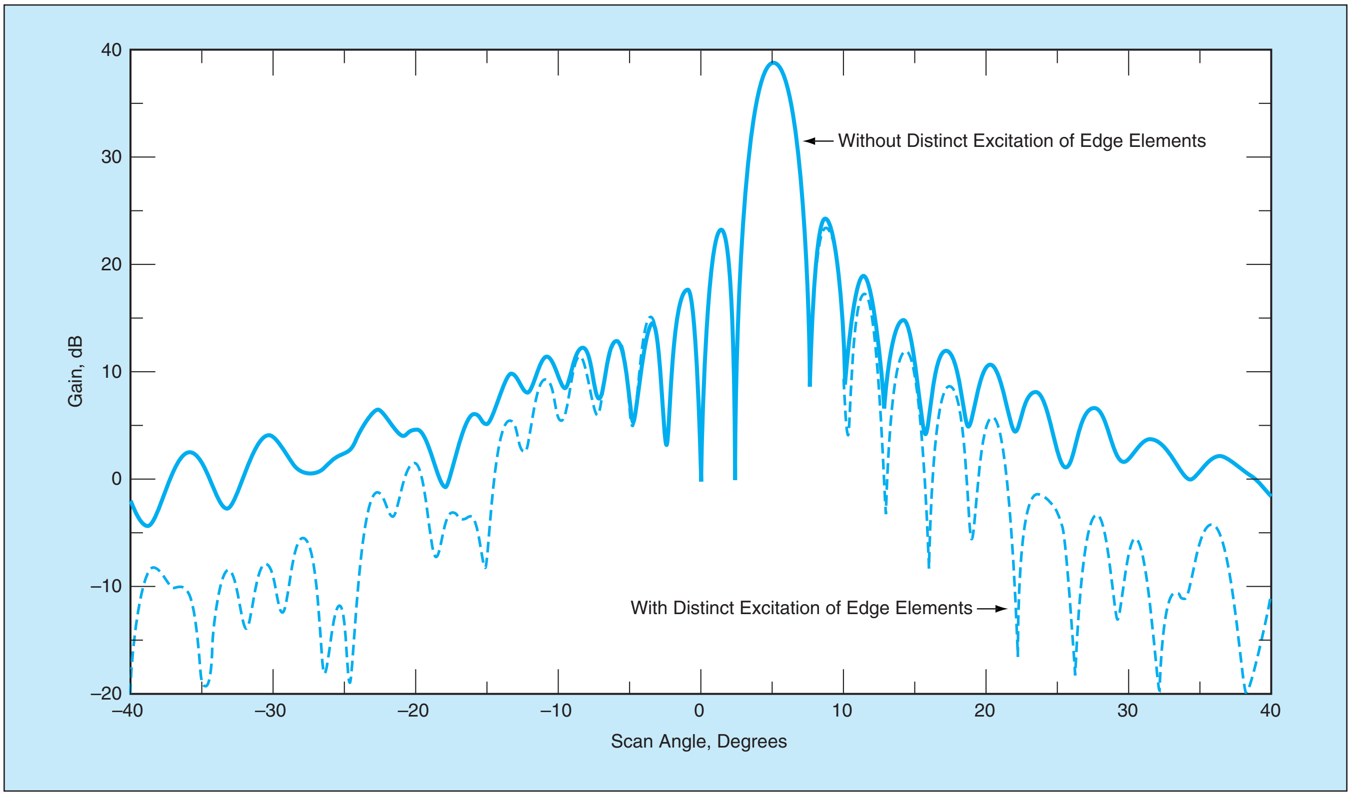

Figure 2. **Results of Numerical Simulations,** with and without distinct excitation of the edge elements, are plotted for a scan angle of 5°.

(that is, the phase difference between adjacent elements) needed to point the main lobe of the radiation beam in a given direction in the (y,z) plane. For an edge radiating element, the excitation coefficient would be of the form

$$we^{j\phi} = a_{\pm N/2}e^{\pm jN\alpha/2}(1+ce^{\pm j\delta}),$$

where w and $a_{\pm N/2}$ are magnitudes; ϕ is the phase of the excitation; c and δ are a magnitude scale factor and a phase shift, respectively, necessary for the desired degree of cancellation of a specified side lobe, and N is one less than the total number of radiating elements.

Computational simulations have been performed, following diffraction-analysis procedures based on a physical-optics formulation. Some of the parameters used in the simulations were a = 5.4 m, b = 3 m, F = 4.32 m, and N + 1 (the number of elements) = 41. The phased array had a length equal to that of the cylindrical axis of the antenna (2b = 6 m) and comprised 41 y-polarized elements spaced at intervals of 0.63 wavelength. The results of the computational simulations showed that the radiation pattern could be controlled with high versatility through control of the edge-element excitation amplitudes and phases. In particular, it was demonstrated that the side-lobe levels could be reduced (see Figure 2) and even effectively canceled and that side-lobe envelopes could be made steeper (side-lobe levels made lower) by choosing, for cancellation, a specific side lobe near the peak of the main lobe. In addition, one could choose the edge-element excitations to obtain different side-lobe envelopes simultaneously on the opposite sides of the main lobe.

This work was done by Ziad Hussein and Jeff Hilland of Caltech for **NASA's Jet Propulsion Laboratory**. *Further information is contained in a TSP (see page 1).*
NPO-30251

Command Interface ASIC — Analog Interface ASIC Chip Set

These are radiation-hard integrated circuits for power-control applications.

NASA's Jet Propulsion Laboratory, Pasadena, California

A command interface application-specific integrated circuit (ASIC) and an analog interface ASIC have been developed as a chip set for remote actuation and monitoring of a collection of switches, which can be used to control generic loads, pyrotechnic devices, and valves in a high-radiation environment. The command interface ASIC (CIA) can be used alone or in combination with the analog interface ASIC (AIA). Designed primarily for incorporation into spacecraft control systems, they are also suitable for use in high-radiation terrestrial environments (e.g., in nuclear power plants and facilities that process radioactive materials).

The primary role of the CIA within a spacecraft or other power system is to provide a reconfigurable means of regulating the power bus, actuating all valves, firing all pyrotechnic devices, and controlling the switching of power to all switchable loads. The CIA is a mixed-signal (analog and digital) ASIC that includes an embedded microcontroller with supporting fault-tolerant switch-control and monitoring circuitry that is