December 1975 B75-10330

NASA TECH BRIEF

NASA Pasadena Office

Highly-Efficient Horn/Reflector Antenna

The problem:

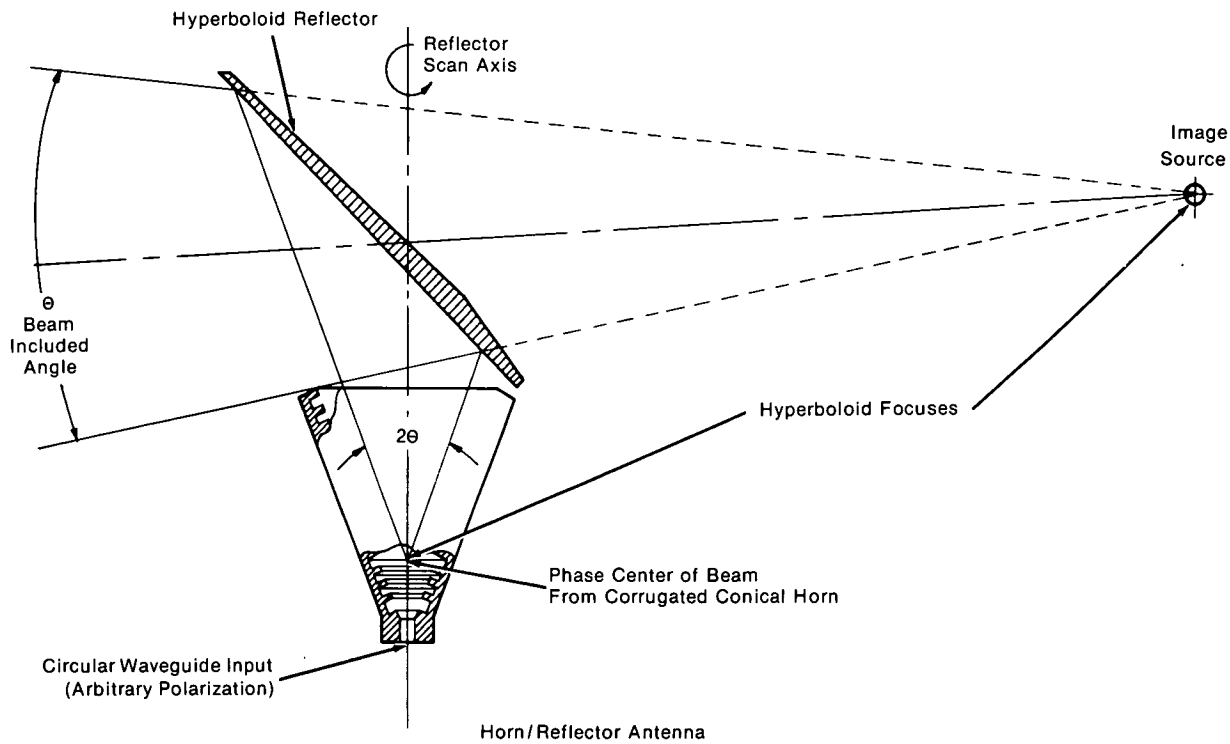
One important concern in the design of directional antennas is to obtain maximum beam efficiency. At this time horn-fed parabolic reflector antennas have beam efficiencies reaching 90 percent. Higher efficiencies are difficult to obtain due to energy spillover and diffraction effects. Conventional designs with greater efficiencies become very expensive and bulky.

The solution:

A new antenna has a beam efficiency of 96 percent. The configuration is compact and relatively inexpensive.

How it's done:

The new antenna includes a corrugated conical horn which illuminates the concave side of a hyperboloid reflector (see figure). The horn produces a circularly-symmetric spherical expanding wave without side lobes. This wave is reflected from the hyperboloid and is radiated into space again as a spherical expanding wave with a different included angle (Θ). Effectively, the radiated energy seems to be coming from an image source located at the second hyperboloid focus. A similar effect can be obtained by using a long narrow-angle conical horn instead of the corrugated one, but the corrugated horn is more compact and is easily scanned.



(continued overleaf)

The key feature to this configuration is that there is no transformation from a flat wave front to a spherical wave front. Normally, energy generated by a directional antenna starts as a flat wave front which transforms to a spherical expanding wave. This transformation creates lossy side lobes. The beam in the new antenna has a spherical wave front at the start.

Tests on a prototype antenna developed with $\Theta = 10°$ show that the portion of the total radiated power contained within the 10° of the pattern maximum exceeds 95 percent. Two areas which contain most of the power outside the 10° off axis are the -20-dB minor lobe and the wide lobes at -40 and -50 dB. Numerical results show that the single -20-dB lobe detracts about 1 percent from beam efficiency. This is due to the compact design and can be improved by using a larger reflector.

The wide lobes at -40 and -50 dB contain about 2 percent of the total power and are due to horn spillover past the truncated reflector tip. Again, a larger reflector would improve the result by at least 1 percent. If all things are taken into consideration, an optimum hyperboloid reflector fed by a corrugated horn is capable of yielding beam efficiencies over 97 percent.

Note:

Requests for further information may be directed to:

Technology Utilization Officer
NASA Pasadena Office
4800 Oak Grove Drive
Pasadena, California 91103
Reference: TSP75-10330

Patent status:

This invention is owned by NASA, and a patent application has been filed. Inquiries concerning nonexclusive or exclusive license for its commercial development should be addressed to:

Patent Counsel
NASA Pasadena Office
4800 Oak Grove Drive
Pasadena, California 91103

Source: Kenneth A. Green of
Microwave Research Corp.
(NPO-13568)

Categories: 01 (Electronics - Components and Circuitry)
02 (Electronics Systems)