REFLECTOR ANTENNAS WITH SUPPRESSED SIDELOBES

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SUMMARY

The gain and null to sidelobe level of the radiation pattern of reflector antennas are very important design parameters which have been under investigation for several years. Previous attempts to increase the gain of reflector antennas include the use of dielectric materials of different dimensions, shapes, volume and dielectric constant homogeneity. However, the resulting dielectric loaded antennas have many disadvantages such as, higher sidelobe level and narrower bandwidth. An alternative approach is to use an array of radiators to excite the antenna. One type of these reflector antennas is the corner array which was introduced by Shell in 1939 [1] and recently re-designed in order to account for the edge diffraction, mutual coupling between and off axis positioning of the radiators [2].

In this summary the radiation characteristics of a class of two-dimensional reflector antennas is investigated. An array of radiators are used to control the aperture field distribution and hence the gain and the side-lobe levels of the far radiated fields. The method of moments is used to find the induced surface current distribution, aperture field and the far field pattern. Since the problem is two-dimensional all radiators are considered to be line sources. The amplitude and phase of the electric current for any of these radiators (say radiator number $n$) are denoted by $I_n$ and $\phi_n$ respectively, whereas the nature of line sources are chosen to be three for practical considerations. Furthermore, two of these sources $(I_1, I_2)$ are placed symmetrically around the center line of the reflector and assumed to have the same current in order to produce symmetric pattern around the $E$-$O$ plane. The remaining source $(I_3)$ is considered to be the dominant radiator for the reflector antenna and the radiation characteristics of the antenna due to excitation by this source in isolation was the subject of improvement by introducing two additional line sources. The amplitude and phase of the current of these sources as well as the angular and radial position are selected specifically to suppress the side-lobe of the far field pattern as well as to enhance the gain of the antenna by reducing the beamwidth.
The numerical results show that the gain is increased and the sidelobe levels are greatly reduced for strip, corner, circular and parabolic reflector antennas by using three line sources with proper choice of their positions, amplitudes and phase. As an example, see Fig. 1 where three line sources are radiating in the presence of a conducting strip of width $2L$, where $L = 13$, $L_0 = .75A$, $I_0 = L$, $I_1 = I_2 = .1$, $\phi_1 = \phi_2 = 0^\circ$ and $\phi_1 = \phi_2 = 32.73^\circ$ and $\phi_1 = \phi_2 = 42.73^\circ$ (where $\lambda$ is the wavelength). It is obvious that the gain of this strip reflector antenna is increased due to the narrowing of the beamwidth from 56.0 to 40.0. Whereas, the sidelobe levels are reduced by approximately 37 dB relative to the corresponding pattern due to the single radiator $I_0$. Similar behavior is also noticed when a 60.0 corner reflector ($L = 2a$, $L_0 = 13$, $I_0 = L$, $I_1 = I_2 = 1.97$, $\phi_1 = \phi_2 = -175^\circ$, $\phi_1 = \phi_2 = 1.77^\circ$ and $\phi_1 = \phi_2 = 96^\circ$) is excited by three radiators as shown in Fig. 2 where the beamwidth changes from approximately 92° to 48° while the first sidelobe is reduced by approximately 17 dB. More results and discussion will be available during the presentation.

REFERENCES


A strip reflector with three radiators

![Diagram of a strip reflector with three radiators](image)

**Fig. 1**: Far field pattern of a strip reflector.
A 60° corner reflector with three radiators

Fig. 2: Far field pattern of a 60° corner reflector.