Radiation Properties of a Large Faceted Reflector Antenna

Bruce Veidt* and Peter Dewdney
National Research Council of Canada
Box 248
Penticton, British Columbia, V2A 6J9 Canada

A new design for a reflector antenna has been proposed called the Large Adaptive Reflector. This antenna will have a diameter of ∼200 metres with a focal length of 500 metres. The primary reflector will consist of reflecting panels supported off the ground by vertical actuators, and the receiver will be supported by a special stabilized airborne platform. The antenna will be steered by moving the receiver and adjusting the shape of the reflector surface to the appropriate section of a paraboloid. This antenna is in general an offset reflector antenna. Because of the long focal length of this antenna, it will be possible to construct reflector panels with a flat (or nearly flat) surface. The radiation properties of this unique faceted reflector antenna have been examined and will be reported in this paper.

Our analysis was based on the Convolution Theorem which allowed us to separate the effects of the radiation pattern of individual panels from the pattern of an assemblage of panels. This greatly reduced the computational complexity of our analysis.

The first part of our analysis was to calculate the reduction in efficiency due to the phase errors resulting from the flat panels. These simulations have shown that flat panels can indeed be used. Operation up to 22 GHz with 80% efficiency is possible with panels as large as 4 metres in diameter. If the panels are constructed with a slight parabolic sag, the diameter can be increased to 5 metres. This amount of sag is ∼3 millimetres for a 5 metre panel and the focal length of the panel is the same as for the entire reflector. This is a significant improvement since it would reduce the number of panels and actuators from 2500 to 1600 per antenna.

The second part of our analysis was to consider the radiation pattern of the faceted reflector. We found that the grating response due to the repeating pattern of panels will be suppressed by nulls in the radiation pattern of the individual panels. However, this effect will be compromised if panel size is less than panel spacing, which would reduce the spacing between the nulls of the panel radiation pattern so that they no longer coïncide with the grating responses. This difference in sizes could result from gaps between the panels or if the surface currents are attenuated near the edge of the panels (as will be the case at long wavelengths), reducing the effective size of the panels.