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THE UNIVERSITY OF MICHIGAN

COLLEGE OF ENGINEERING

DEPARTMENT OF ELECTRICAL ENGINEERING

Radiation Laboratory

4700-1-F = RL-2115

FINAL REPORT

by

Raymond F. Goodrich

June 1962

Purchase Order 90044-680362

Contract With: International Business Machines Corporation
Space Guidance Center
Federal Systems Division
Owego, New York

Administered through:
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I

INTRODUCTION

In the course of our discussions of the XB prototype radar antenna, two main problems arose: The first was the initial failure of the antenna to meet the pattern specifications due to the failure to take into account the inherent dispersive behavior of slot couplers. This problem was successfully solved by Dalmo-Victor. We offer some comments on this in section II below.

The second problem was the "isodop" problem which imposes a restriction on the azimuthal beamwidth as long as the data processing does not make use of all the available information. We consider this in more detail in section III below.

II

ANTENNA ARRAY DESIGN

The use of slot coupled elements in a linear array always implies a certain phase dispersion at each slot coupler. The dispersive behavior is an essential effect so that the amounts of dispersion at each slot need be parameters in designing for a given aperture illumination. In fact, over the given frequency range a knowledge of the dispersion and a then predictable change in "trombone" lengths has been used by Dalmo-Victor to obtain a constant dispersion over the frequency variation.

The refinement of this scheme might lie in the use of a combination of corporate and trombone feeds. The point being that since the dispersive phase errors are cumulative on passing from slot to slot a reduction in the number of slots in series by the use of a parallel feed arrangement would reduce the cumulative phase error.

We conclude our discussion of the antenna feed system by noting that the Dalmo-Victor system has made use of the slot dispersion as parameters in the design and the result has been most successful.

III

THE ISODOP PROBLEM

The isodop problem has been treated in some detail in a different context by Klauder, et. al.* They were concerned with "chirp" radar systems and in some detail considered the problem of side lobes in the time domain. The problems are equivalent since chirp systems impose a linear frequency modulation on the signal while the high resolution radar schemes make use of the linear frequency modulation caused by the radial velocity of a target in the beam.

Since the isodop problem is formally the same as the chirp problem we can then relax the beamwidth restriction as long as we can go to more sophisticated data processing as described by Klauder, et. al. That is to say, the aperture size is not a restriction in principle but the greater complexity of the processing can be a limitation. Hence for a given system restriction on the aperture, the processing can be specified; for a given processing scheme, the minimum aperture is fixed.

* Bell System Technical Journal, 39 , pp. 745-808 (1960).