MEASUREMENT OF A LARGE ACTIVE PLANAR ARRAY FOR SPACEBORNE RADAR USING NEAR-FIELD SCANNING TECHNIQUES

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ABSTRACT

The requirement to calibrate and test a large active pulsed planar array RADAR antenna, such as ASAR, places certain requirements on the measurement facility and analysis software that are perhaps not encountered in other areas of application.

1. INTRODUCTION

2. RANGE OVERVIEW

The construction of a new large planar near field test facility at MMS in Portsmouth was begin in 1995. Indoor facilities are usually preferable for space antenna testing as they offer a clean, dry, screened, covert, anechoic environment that is thermally and seismically stable. Such facilities typically operate with a significant reduction in antenna under test (AUT) probe separation, which is a consequence principally of economic constraints, and as such tend to be indirect measurement techniques.

The large size and complexity of this instrument, combined with the considerable quantities of electrical and mechanical support equipment (EGSE and MGSE respectively) needed for its correct functioning introduced a requirement that the antenna not be moved during the measurement process. This, coupled with the commensurate geometries identified the plane rectilinear near field methodology as the preferred technique.

The size of the measurement plane was governed by the size of the effective radiating area of the antenna, 10m by 1.3m, the requirement to provide far field data that is valid out to an angle of ±70° from boresight with an uncertainty of ±2dB rms at a level of 40dB below peak., and the desire to minimise coupling between the AUT and the scanning probe. With this in mind the scan plane was chosen to be 22m wide and 8m high. In addition to offering the capability of measuring planar array antennas up to 16m by 2m, this also fulfilled the requirement for measuring a wide range of antenna classes including typical Earth coverage communication antennas such as deployable Gregorian reflector assemblies.

The positioner subsystem is housed within a 27m by 12m by 12m temperature controlled class 3 clean room that has been screened and offers a typical isolation of better than 70dB over a frequency range that extends from 100MHz to 40GHz. The installation of mainly 18 inch RAM has been used to reduce those effects associated with multipath within the facility. Previously studies (Ref 1.) have shown that covering the front and rear walls as well as the ceiling and walls out to beyond the AUT is typically sufficient for the purposes characterising a variety of medium to high gain antennas, *e.g.* Earth cover horns, SAR and front fed spot beam antennas.

The RF measurement subsystem comprises an adapted HP85301b measurement. This system is capable of making multiple frequency pulsed, multi-polarisation measurements whilst utilising fast TTL triggering. The principal modifications were associated with overcoming the very long RF cables.

The intention of most antenna range tests is to compare the instruments measured far field performance with that of a theoretical prediction or to demonstrate compliance with an acceptance test criteria. For the case of the ASAR antenna, one additional objective was to identify defective or incorrectly adjusted radiating elements and transmit and receive (TR) modules.

Conventionally, the AUT is orientated in the range so that its mechanical interface is aligned to the axes of the range. However, due to the considerable size and mass of the ASAR instrument and MGSE it was quite impossible to perform this alignment operation with any degree of precision. Instead, the orientation of the AUT with respect to the range was determined with the use of a precision contacting probe. The alignment corrections were then rigorously applied within the transformation software so that far field data could be plotted with reference to the desired mechanical interface.

The ASAR antenna has been designed so that the azimuthal beamwidth is very narrow. The result of this is far field data must be tabulated on a very fine abscissa. This precluded the use of a fast Fourier transform (FFT) as to obtain the required angular density of data that a large number of points are required over a very which is that

The technique of microwave holographic metrology (MHM) was employed to recover the aperture plane of the AUT and facilitate in the diagnosis of various anomalies. Again alignment data was used to correct the recovered aperture illumination function as this insured that the results remained clearly "focused" and were free from spurious phase tapers.

9. REFERENCES

1. "The Implementation and Validation of a Large 22m by 8m Planar Near-Field Test Range for Space Antenna Systems and Payload Testing", P.R. Miller, J. Ward, P.R. Prowting, S.F. Gregson, IEE 10th International Conference on Antennas and Propagation, 14-17 April 1997.