IMPROVED COMPACT ANTENNA TEST RANGE (CATR) PERFORMANCE BY USING SPHERICAL ANGULAR FUNCTION (SAF) DECONVOLUTION METHOD

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Abstract :

Microwave antenna measurements seek to determine the response of an Antenna Under Test (AUT), when it is illuminated by a uniform Plane Wave. The requirement of a uniform Plane Wave illumination can be achieved by utilising a CATR. The potentially low cross-polarisation levels have made CATR one of the most suitable and accepted solution to test and verify the performance of spacecraft antennas. However, antennas with frequency reuse require very low levels of cross-polarisation and so need an improvement of existing CATR. In this context, the present work is intended to find the most suitable solution to reduce the problem of cross-polarisation arising from the CATR itself.

The sources of cross polarisation errors in CATR are well-known but their minimisation is a source of much debate. It appears that a deconvolution process performed from integral formulations, based on Spherical Angular Functions (SAF) techniques [1,2], exhibits some interesting advantages. The advantages are that SAF techniques offer no limitations on the AUT types and no special measurement's procedures are required. So, SAF techniques have been selected and implemented by SATIMO and TICRA to correct sources of cross-polarisation.

The problem for improving CATR performance is to extract the intrinsic AUT SAF from CATR measurements. The first step consists to determine the SAF of the CATR Quiet Zone (QZ). This is achieved by expanding in spherical modes the incident field distribution measured (or computed) on a sphere (or a cylinder) surrounding the CATR QZ where the AUT will be located and by transforming to the far-field to obtain the CATR QZ SAF. In the second step, the induced voltages at the AUT terminals are measured when AUT is introduced in the CATR QZ. Then, the extraction of the intrinsic AUT SAF by using SAF techniques requires a numerical deconvolution of coupled voltages induced on the AUT by the incident fields generated in the QZ by the CATR.

The knowledge of the incident fields existing in the QZ of the CATR can be predicted by numerical simulation, or measured directly by experimental NF scanning. Two different geometry of NF scanning of CATR QZ (which correspond to the two most relevant geometry) have been investigated : cylindrical and spherical. Then, NF to FF transformations have been used to obtain desired SAFs. Special efforts have been made on the coupling algorithm from the view of spherical mode expansion. Our method will be compared to existing methods.

A trade-off and selection of the most promising methods have been performed under ESTEC Contract n°12878/98/NL/NB and implemented in the ESTEC CATR.

[1] J. Ch. Bolomey, “Réponse d’une Antenne de Reception à une Onde Incidente Non-Plane” (“Response of a Receiving Antenna to an Incident Non-Planar Wave”), Ann. Telecomm., Vol 34, No. 9-10, 1979.

[2] B. J. Cown, C. D. Papanicolopolus, and R. W. Cravey, “In-Band Antenna Coupling Research”, Final Technical Report, Georgia Institute of Technology, GTRI, Contract No. CECOM-TR-82-J069-F, June 1986.