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Computations and Measurements for Finite Frequency Selective Surfaces

J.P. Estienne¹, L.J. van Ewijk², D.R. van der Heul³, H. Schippers^{4,5}

Introduction

The aim of this paper is to evaluate the accuracy and efficiency of different numerical models for the analysis of Finite Frequency Selective Surfaces (FFSS). The results of numerical models are compared to each other in relation to data of measurements. The elements of the FSS to be analysed are rectangular slot apertures and Jerusalem cross apertures. The elements are embedded in configurations of increasing complexity. The configurations are:

1. Isolated conducting sheet with rectangular slots.
2. Conducting sheet with elements on a Teflon substrate (with thickness much less than the wavelength of the incident electric field).
3. Conducting sheet with elements, embedded between a Teflon substrate and a radome of glass epoxy (see Figure 1), where the thickness of the substrate is less than the wavelength, while the thickness of the glass radome is comparable with the wavelength of the incident field).

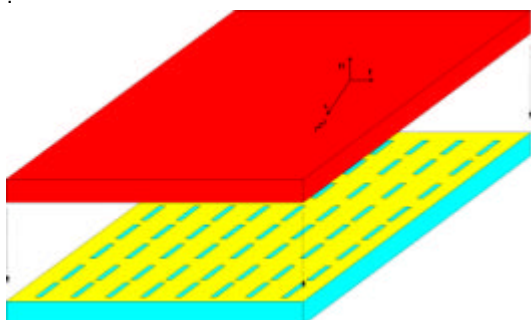


Figure 1 Schematic illustration of band pass FFSS consisting of conducting sheet, embedded between a Teflon substrate (blue) and a glass-epoxy radome (red).

Modelling

In general FSS are analysed by using a Method of Moments (MoM) approach with periodic basis functions. Under the assumption the element/aperture array is finite but sufficiently large a similar approach is often used for the analysis of FFSS. Here, this assumption will not be made and the finiteness of the supporting structure of the array will be taken into account.

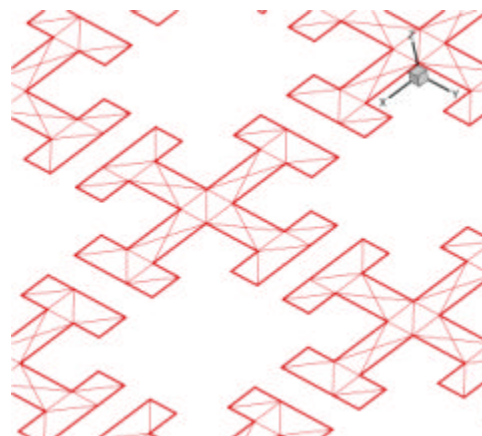


Figure 2 Detail of computational grid for boundary integral equation.

In this paper the following full-wave modelling approaches are applied:

1. An extended Electric Field Integral Equation approach, where the dielectric properties of the substrate are locally modelled by an appropriate surface impedance (see also Figure 2).
2. A combination of Electric Field and Magnetic Field Integral equations for the dielectric layers using the equivalence principle.
3. An hybrid Finite element boundary integral equation approach where the dielectric layers are modelled by finite elements.

Measurements

Samples of different finite FFSSs with a typical size of 0.25 m x 0.25 m, containing 64 elements/apertures have been measured for incident waves in the 5-15 GHz spectrum.

Evaluation

The results of the different numerical models will be compared to the experimental results for their accuracy in predicting the correct frequency dependent response for a range of incident wave directions centred on normal incidence.

¹ EADS-CCR, BAT Centreda 1, 4, Avenue Didier Daurat – 31700 Blagnac Cedex- France

² TNO Physics and Electronics Laboratory, P.O. box 96864, 2509 JG The Hague, The Netherlands

³ National Aerospace Laboratory, P.O. box 90502, 1006 BM, Amsterdam, The Netherlands.

⁴ National Aerospace Laboratory, P.O. box 90502, 1006 BM, Amsterdam, The Netherlands.

⁵ Corresponding author; email address:schippiw@nlr.nl