PIERS 1998

Progress In Electromagnetics Research Symposium

PROCEEDINGS

Volume 1

July 13-17, 1998
Nantes, France

Organised by
The Electromagnetics Academy
CESBIO, IRESTE, Université de Nantes
CESBIO, CNES-CNRS-Université Paul Sabatier, Toulouse
Institut Universitaire de Technologie, Université de Paris X

Session HO3
Tuesday, July 14, PM 13:40-17:20
Room R02
Composite Material Modeling II
Workshop on Complex Media and Measurement Techniques

Chairs : Mac Phedran, A. Priou

The Design Principles and Measurement of Surface Wave Absorbing Materials

F C Smith
Department of Electronic Engineering, University of Hull, Hull, HU6 7RX, UK
Email : F.C.Smith@e-eng.hull.ac.uk

S Y M R Stroobandt
ESAT-TELEMIC, K.U.Leuven,
Kard. Mercierlaan 94, B-3001 Heverlee, Belgium

Surface waves are waves which propagate along an interface of two different media without radiation [l]. Surface wave absorbing materials are used to reduce and redirect the power scattered by several classes of scatterer. The perfect electrical conductor (PEC) half-plane shown in Figure 1 is a generic scatterer which will be used to illustrate the theoretical and experimental techniques necessary for the development of optimized surface wave materials.

The PEC half-plane in Figure 1 is coated with a surface wave absorbing material and is illuminated by a TEM wave at near grazing incidence. The diffracted power at the principal discontinuity is reduced through absorption of the propagating surface wave mode; usually the fundamental electric mode. From a scattering viewpoint, the magnetic mode is often less important to grazing incidence TEM incident waves. The material properties of the surface wave absorber are chosen to optimise power absorption in one or more of the electric modes. However, for absorption to take place it is necessary for energy in the incident wave (normally a TEM wave) to be converted into the propagating surface wave mode. For the treated planar edge in Figure 1, mode conversion takes place at the discontinuity between the absorber and the half-plane closest to the source. The mode conversion site is a second discontinuity which can contribute to the power scattered by the treated half-plane. Surface wave absorption, mode conversion and diffraction at the two discontinuities all impinge on the design of surface wave absorbers. There are also secondary effects associated with half-plane scattering which affect further the performance of the absorber. Planewave absorbers are guaranteed to reduced scattering from planewave sources: no similar guarantee applies to the use of surface wave absorbing materials.

In [2], the authors introduced a new technique for characterizing the propagation properties of planar surface waves. This technique is extended to characterize multi-layer surface wave absorbers. Theoretical analysis of the design constraints described above is combined with the experimental technique described in [2] to investigate scattering reduction through the use of surface wave methods. Other techniques for reducing half-plane diffraction are also considered in the light of the surface wave results.

References
[l] H.M.Barlow, J Brown, 'Radio Surface Waves', Oxford University Press, 1962, p 5
[2] S.Y.M.R. Stroobandt, F.C. Smith, 'Method for Measuring the Attenuation and Phase Constants of a Surface Wave Propagating Along an Infinite Plane', Electronics Letters, Vol. 33, No. 20, September 1997, p 1685

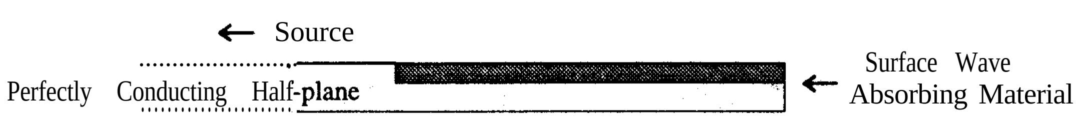

Figure 1 **:** A PEC half-plane treated with a surface wave absorber. The PEC half-plane is cause of unwanted scattering in several areas including antennas and RCS.