The coherent electromagnetic field by a particulate media – numerical implementation in a planar geometry

Gustavsson, Magnus; Kristensson, Gerhard; Wellander, Niklas

2021

The coherent electromagnetic field by a particulate media – numerical implementation in a planar geometry

Magnus Gustavsson[1], Gerhard Kristensson[2], and Niklas Wellander[1]

[1]Swedish Defence Research Agency, FOI, SE-581 11 Linköping, Sweden
[2]Dept. of Electrical and Information Technology, Lund University, SE-221 00 Lund, Sweden

Scattering of electromagnetic waves by a particulate media is addressed. In general, the non-intersecting particles can be of arbitrary form, material and shape with number density n_0 (number of scatterers per volume). The main aim of this paper is to calculate the coherent reflection and transmission characteristics for a collection of spherical particles confined within two parallel planes. Typical applications of the results are found at a wide range of frequencies (radar up to optics), such as attenuation of electromagnetic propagation in rain, fog, and clouds etc. The integral representation constitutes the underlying framework of the solution of the deterministic problem, which then serves as the starting point for the solution of the stochastic problem. Conditional averaging and the employment of the Quasi-Crystalline Approximation lead to a system of integral equations in the unknown expansion coefficients. The planar geometry and normal plane wave incidence imply a system of integral equations in the depth variable. The system of integral equations is solved by the Nyström's method and Gauss-Legendre quadrature. Numerical examples are presented and the results are compared with the tenuous and low frequency approximations as well as the reflection and transmission of a homogenized slab.