Characterization of the relevant parameters in diffusive media, application to the near subsurface imaging

The characterization of complex media with electromagnetic waves is nowadays exploited in several domains as biological, medical, environmental, ... In this proposal, we focus on the characterization of the moisture of the near subsurface. In real situation, the illumination area contain a lot of scatterers and in most cases, the useful informations to characterize the scatterers and the heterogeneities are statistics, or spatialized. Instead of working with inverse algorithms where the desired quantity is a map of electromagnetic index - in this case, the heterogeneities are considered as disturbances and as sources producing clutter - we propose to use the diffusion phenomenon to find information not just on the scatterers, but on the scattering matrix including these scatterers. For this, inverse procedures based on the radiative transfert equation have been developed. The objectives are here to determine quantities such as the mean size of the scatterers, their concentration, their asymmetry factor, knowing the embedding medium [Peraiah2002].

This internship is made in the context of a project whose goals are to characterize the moisture of the near subsurface - which is a heterogeneous medium - using electromagnetic wave probing. The objectives of this internship are first, to determine the relevant diffusion parameters in this framework. The sensitivity of theses parameters will be then studied according to their density, their size, spatial distribution, permittivity of the embedding medium, illumination frequency, polarization of the illumination wave, ... The student will make experimentations on several media with different compositions with different nature of the heterogeneities, their density, the nature of the embedding medium, ... The measurements will be performed with a scanner placed inside an anechoic chamber allowing to move the transmitting and the receiving antennas in an independent way. The fields will be measured with a setup based on a Vectorial Network Analyzer [Nounouh2015a], [Nounouh2015b].

Keywords : Electromagnetism propagation - Diffusion phenomena - Microwave measurements - Hyperfrequency - Diffusion coefficient - Vectorial Network Analyser - Dispersive medium

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Applicant profile

The applicant must have good background in physics and more specifically in electromagnetism and microwave specificities.

Contact : Christelle Eyraud - christelle.eyraud@fresnel.fr
Institut Fresnel, Equipe HIPE
`http://www.fresnel.fr/spip/spip.php?rubrique32&lang=en`
Campus de Saint-Jérôme, F13397 Marseille, France