MODELLING OF VHF RADIO PROPAGATION INSIDE FOREST USING A PARABOLIC EQUATION ALGORITHM

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INTRODUCTION

The development of future telecommunication and detection systems requires accurate prediction models in order to obtain optimal performances. Our laboratory has been working since several years, both experimentally and theoretically, to improve the understanding of VHF ground propagation and transmission in forested environments.

PROPAGATION MODELLING INSIDE FOREST

It is well known that the signal is highly fluctuating when the receiving antenna is immersed in the vegetation. This chaotic behaviour is due to the presence of multiple scatterers that are randomly located, causing strong multipath interference and deep fading (M. Le Palud et al., *IEEE RADAR 2000 Conf. Proc.*). It is yet interesting to be able to predict a mean signal level (i.e. a local spatial average) by replacing the vegetation bulk, which is a complicated mixture of air, wood and leaves, by a smoothly-varying equivalent medium. Following this approach, some important works (T. Tamir, *IEEE AP*, Vol 25, n° 4, 1977) have been achieved in order to obtain closed-form solutions, which allowed the discussion and interpretation of the phenomena; however, crucial hypothesis had to be made, like:

- homogeneous medium
- constant height of trees
- flat ground
- range-independent parameters

Our own goal was to compute the field inside a forest, without the preceding restrictions, for irregular-terrain situations like the one represented on figure 1.

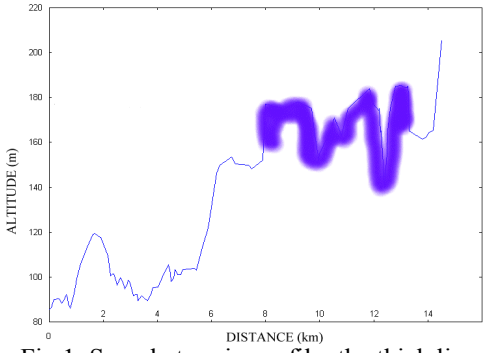

Fig.1. Sample terrain profile; the thick line corresponds to the forest

In previous works, we have used a parabolic equation algorithm to compute VHF propagation over the forest. The top of the trees was considered as the ground surface (lower boundary) with special values of electromagnetic parameters. With this approach the values of the field inside the forest cannot be obtain directly. So we have decided to modify our algorithm in the following way: the vegetation is know considered as the lower layer of the atmosphere and is characterised by a refractive index n and an attenuation factor A. These two parameters may vary with height and range. The results obtained by this method have been confronted with those given by other approaches and with experimental data. The influence of the vertical profile of the forest (i.e. variations of n and A with height) on the field distribution has also been investigated.