STATISTIAL ANALYSIS OF THE ELECTROMAGNETIC FIELD SCATTERED BY THE OCEAN SURFACE IN VARIOUS WEATHER CONDITIONS: A NUMERICAL STUDY IN L-BAND.

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1. INTRODUCTION

The electromagnetic scattering from the ocean is a research field of the most importance for civil coastal surveillance, naval detection, satellite remote sensing or for any ocean-monitoring activity. This is the reason why many research teams have developed different electromagnetic models to describe the scattering by the sea surface. Most of the time, these models consider the ocean surface as a random rough surface and apply various asymptotic approaches [1]: Small-Perturbation Method (SPM), Kirchhoff Approximation (KA), Small Slope Approximation (SSA), Two Scale Model (TSM),...

If the assumptions of these approaches are satisfied, these models can provide a reliable estimation of the mean value of the scattered field for different incident and scattered directions and in various weather conditions. Nevertheless, a mean value is not enough to evaluate the observability of the ocean characteristics.

In this paper, we present a numerical study applying a Monte-Carlo approach to evaluate the mean value and the standard deviation of the scattered field in L-Band. Our purpose is to estimate the observability of the weather conditions for different incident angles in backscattering configuration.

2. SEA SURFACE GENERATION

To generate a realistic ocean surface associated to a given weather condition (wind speed and wind direction), we introduce a realistic sea spectrum developed by Elfouhaily et al. [2]. This sea spectrum is in the form:

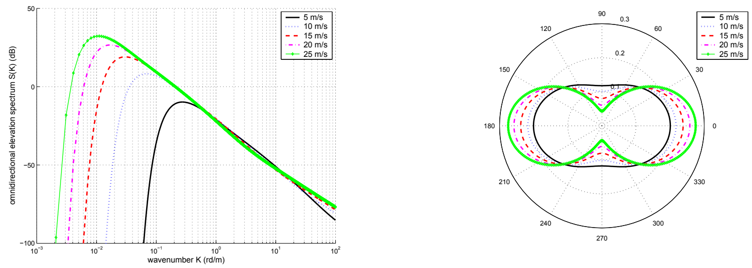
$$S(K,\phi) = M(K) f(K,\phi) \tag{1}$$

where $M(K)$ represents the isotropic part of the spectrum modulated by the angular function $f(K,\phi)$, and where K and ϕ are respectively the spatial wave number and the wind direction, see figure (1). Then, the convolution of this spectrum with an unitary white gaussian random signal generates a one-dimensionnal profile that represents an ocean surface for given weather conditions, see figure (2).

3. NUMERICAL METHOD

To compute the electromagnetic field scattered by the ocean surface so generated, we apply an efficient Method of Moments (MoM) called the Forward-Backward method (FB-MOM). In its original formulation [3], the Forward-Backward method only applies to scattering from perfectly conducting surfaces. More recently, Iodice [4] presented a modified version that can take into account the dielectric properties of the sea water.

Then, considering this scattered field as a known function of the incident angle, the Monte Carlo approach enables the estimation of the statistical properties of this scattered field: the mean value and the standard deviation.



(a) *Omnidirectional elevation spectrum* (b) *Angular function*

Fig. 1. Elfouhaily sea surface spectra with different wind speeds.

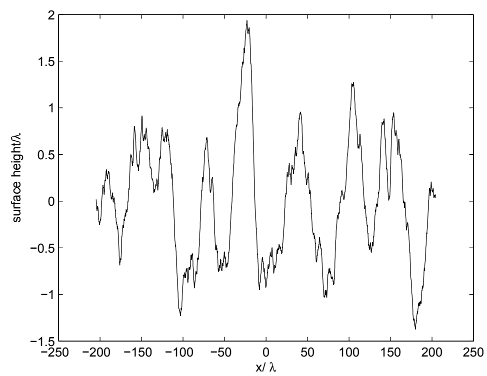


Fig. 2. Realization of an ocean surface.

4. OBTAINED RESULTS

Based on the statistical characteristics of the scatttered field and using a contrast criterion, we can evaluate the observability of the wind speed as a function of the incident angle and for different polarizations (vv and hh). The obtained results show that this observability is significantly influenced by the incident angle and the polarization.

5. REFERENCES

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