CHARACTERISATION OF MARINE SPECKLE USING MULTI-FREQUENCY SAR IMAGERY

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INTRODUCTION

The SAR is an coherent imaging radar that allows for the acquisition of Earth observation using microwave frequencies, ensuring the ability to operate in all weather conditions. The SAR observations have contributed to a wide range of applications, both for military and civilian purposes, being of paramount importance for marine and maritime applications [1, 2].

All coherent imaging processes, such as those involved by SAR, are affected from speckle. It has been shown that once a tailored model is available [3,4], marine speckle, often associated with the form of multiplicative noise and indeed mitigated by use of multiple looking techniques, can be informative.

From a physical viewpoint, the speckle (which is the low-pass filtering of the fading), arises from the fact that, for each rough resolution cell, the overall complex electromagnetic field Eˆ is the outcome of the coherent sum of Ns elementary complex contributes each characterized by a random amplitude and phase (Figure 1) .

As a result, the total received field can be mathematically modelled using a 2-D random walk, with independently and identically Gaussian distributed real and imaginary components; the amplitude has a Rayleigh probability distribution and the intensity has a negative exponential distribution[5].

The Rayleigh distribution model for the amplitude of backscattered signal, which is associated to the socalled fully developed speckle has been shown to fit well homogeneous land scenes and sea surface when a large area is illuminated by the radar or under a negligible long-wave modulation condition [6].

REFERENCES

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RESULTS & CONCLUSIONS

Promising results are obtained using showcases that refer to C-band and X-band SAR scenes collected under low-to-moderate wind regimes, with the aim of showing the different behavior of the speckle as a functionof both wind speed and as the spatial resolutions of the sensors are presented.

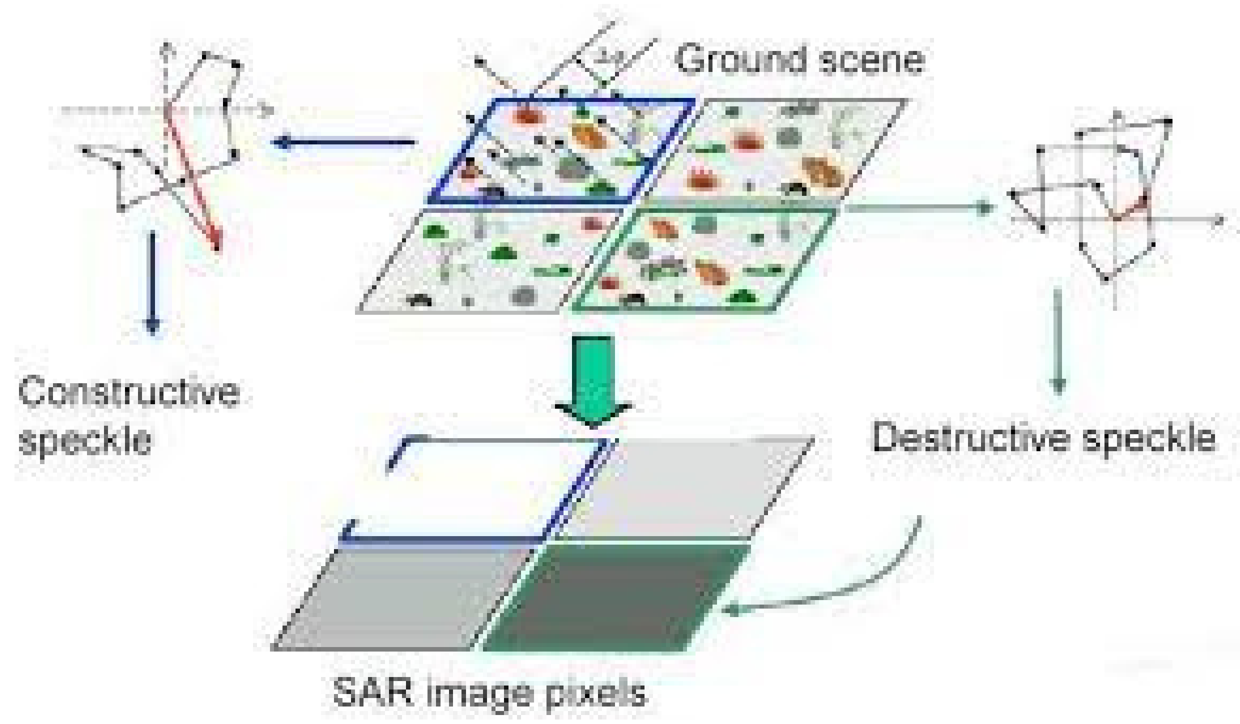

Figure 1: SAR speckle process

METHODOLOGY

In this study, the Synthetic Aperture Radar (SAR) image speckle over marine scenes is modelled and tested over both C-band and X - band SAR imagery at variance of wind speed.

A data set of Sentinel-1 single-look complex dual-polarimetric C-band and Cosmo Sky Med complex HH X-band SAR scenes spatially collocated, acquired under different wind regimes – from low to moderate -is processed using a twofold approach. On one side, the intensity of co-polarized speckle components, in X-band and C-band, is estimated against wind speed (Figure 2); on the other side, their statistical distributions are analysed by using normalized intensities moments (NIMs) are related to wind speed (Figure 3) .

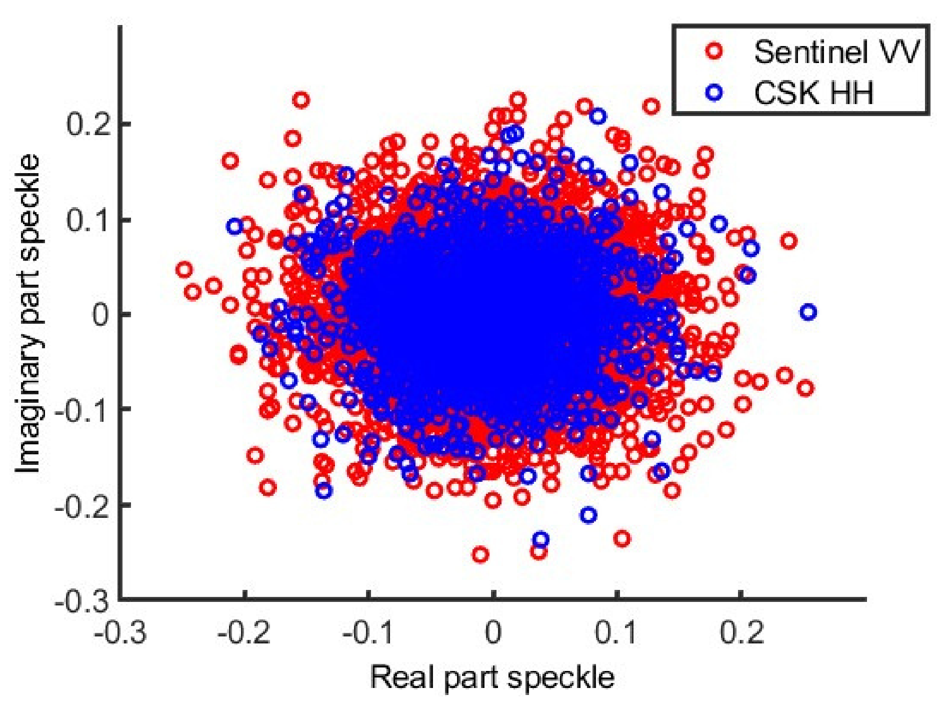

Figure 2: the intensity of co-polarized speckle components, in X-band(blue) and C-band (red)

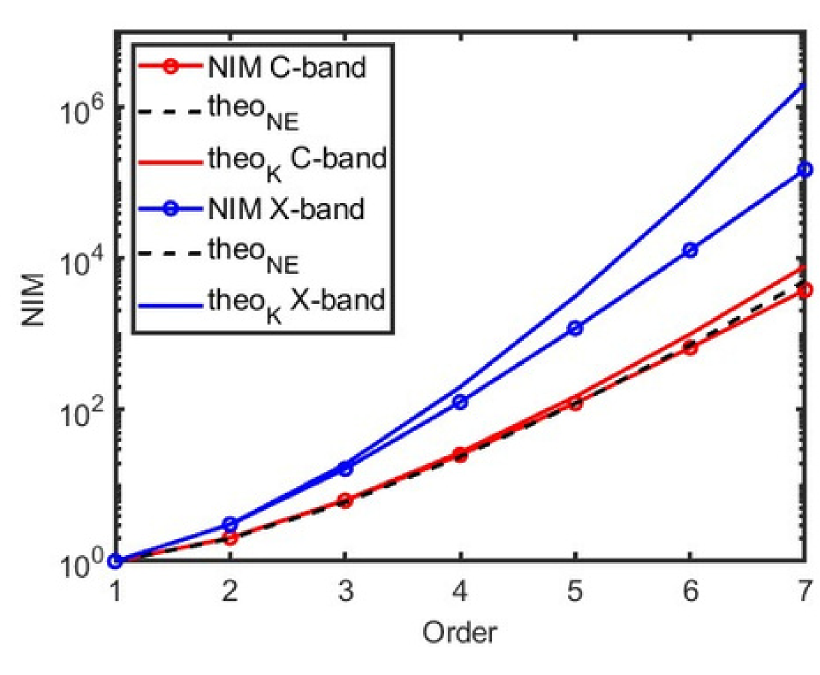

Figure 3: Normalized intensities moments, in X-band (blue) and C-band (red)