Detection of Oil Spills in SAR Images Using Wavelets and Region Growing

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Abstract. This paper proposes an algorithm to detect oil spills in Synthetic Aperture Radar (SAR) images that can be used to support environmental remote monitoring. The proposed algorithm combines the region growing approach and the multiresolution analysis employed by the undecimated wavelet transform to localize dark areas in the sea. The undecimated wavelet applied to the test image smooths the speckle noise while enhances edges providing a better result of the proposed segmentation algorithm that is achieved by a modified region growing approach.

1. Introduction

In the last decade SAR systems have been playing an important role in remote sensing of environmental disasters. Spillage of oil in coastal waters can be a catastrophic event. The potencial damage to the environment and economy of the area at stake requires that agencies be prepared to rapidly detect, monitor, and clean up any large spill [1]. Studies have been carried out to improve methods to detect them. In [2] Liu et al. proposed algorithms to detect and track mesoscale oceanic features employing multiscale wavelet analysis using the 2-D Gaussian wavelet transform to track oil slicks, eddies, fronts, whirlwinds and icebergs. The authors followed the methodology used for automatic detection of oil spills using SAR images that is: 1) an area of interest is selected in the image; 2) the noisy image is filtered; 3) the image area is segmented; 4) features are extracted from the isolated area; 5) the dark areas are classificated into oil slick or look-alike, based on the features. In this paper we develop algorithms related to the steps 2 and 3 and further developments will include the steps 4 and 5.

2. The Proposed Algorithm

In the proposed algorithm the undecimated wavelet achieves a smoothing effect over the noisy image as a preprocessing step to start the region growing process. Before starting it, the seed pixels are automatically search in the histogram of the image corresponding to the first scale of the wavelet decomposition using the à trous algorithm [3]. The regions grow around the seeds according to a similarity measure over the smoothed image.

3. Experimental Results and Conclusions

The proposed algorithm was applied to a real SAR image of an oil spill accident. It is provided in the site http://earth.esa.int/ew/oil_slicks/north_sea_96/.The scene in Figure 1a is in the North Sea and It has been acquired from the ERS-2 satellite on July 18 1996. Figures 1b and 1c show the results of the proposed algorithm applied to the smoothed SAR image using the undecimated wavelet decomposition and applied to the noisy image, respectively. In Figure 1d it is shown the same image segmented by the Liu's algorithm proposed in [2].

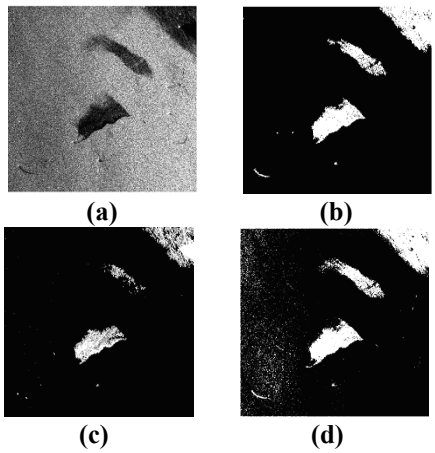

Figure 1. a) The original image b) the segmented version over the smoothed image c) the segmented version over the noisy image d) the Liu's algorithm result.

The results show that the proposed algorithm produces the best segmentation of the dark areas including the oil spills, as a prior task to posterior classification.

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4. References

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