MORPHOLOGICAL FILTERING OF SAR INTERFEROMETRIC IMAGES

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1. INTRODUCTION

SAR and differential SAR interferometry are operational tools for monitoring surface deformation and topographic profile reconstruction. However, the performances of these two techniques are limited by temporal (i.e. surface inside the resolution element is changed due to long period cover) and spatial decorrelation (i.e. acquisition geometry changes between the two acquisitions dates) [1]. These disturbances are translated to an additional noise witch strongly compromise the phase unwrapping process thus the accuracy of the results. Therefore, a suitable method has to be used to improve the quality of the data before exploiting the phase. In the literature, several methods have been proposed to reduce the interferometric phase noise [2] and some of them used basic mathematical morphology operators [3]. All these techniques, however, involve the loss of image detail to a certain extent. In this paper, we introduce a new morphological filter which is based on a modified alternating sequential filter. This filter is applied to the wrapped phase field with the objective of improving its quality. It's another filtering strategy that takes into account the properties of this type of images (fringes pattern). The performances of this filter are discussed and compared to other existing filters under different conditions. Both simulated and real data have been used for that purpose.

2. MORPHOLOGICAL METHODOLOGY

The proposed technique uses tow interferograms: the original one and the same interferogram shifted. This is done to filter the same pixel P in two different positions on the two interferograms. The morphological filtering result is then obtained by combining the outputs of both filtering stages. Thus, for both original and shifted interferogram, we try to estimate the direction of the gradient. This direction is considered to define the shape of the structuring element to be applied. But, before this estimation, it is necessary to make a pretreatment step which consists in smoothing the image to keep only the meaningful forms to ease the estimation step. To do this, we used a mathematical morphology smoothing technique (iteration of opening and closing with different structuring elements). Then, we estimate the gradient on a window by finding the minimum distance between the

central pixel and its neighbors. The direction of the first structure element is defined as orthogonal to the gradient in order to preserve the fringe direction. The two structure elements nearest directions are also considered to make more flexibility (the fringe direction could be misestimated and be little shifted to the real one). After that, we apply on both interferograms the alternating sequential filter with geodesic reconstruction as it provides greater fidelity to the original interferogram through reconstruction. The alternating sequential filter is applied using the three segments obtained by the previous step. The geodesic reconstruction according to the original interferogram preserves the fringes level. The two steps of gradient estimation and filtering are reiterated on 3x3, 5x5 and 7x7 window. The next step is the combination of the two filtered interferograms by selecting the pixel value approaching the fringes pattern i.e. gives the smoothest fringes. Finally, we apply again the alternating sequential filter with reconstruction on the resulting interferogram to remove some residues.

3. RESULTS

The new proposed filtering technique was tested on both simulated and real data with different levels of noise. Then it was evaluated for simulated images according to the mean squared error. The robustness of this filter is also tested by comparing it to other existing filters [2] [4].

4. REFERENCES

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