REGISTERING INTERFEROMETRIC SAR IMAGES USING MARR-HILDRETH ZERO-CROSSINGS

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ABSTRACT:

Leberl (Leberl, 1990) proposed an edge-based algorithm for finding matching pairs of points in SAR images. In this paper, we show that the algorithm can be used to register interferometric SAR images which requires sub-pixel precision. This precision is achieved by interpolating the discrete values of the metric used for matching, in this algorithm, using cubic B-splines. The interferogram obtained is comparable to that obtained using cross-correlation.

1. INTRODUCTION

In the algorithm proposed by Leberl, the Marr-Hildreth operator is used to smooth the images and then find the laplacian. The resulting images have positive and negative values. These images are thresholded at zero and the resulting binary images used to find the matching points. The metric used for matching is the number of matching pixels in corresponding windows of the images.

2. A FAST ALGORITHM

The computation of the metric can be made efficient by finding the number of matching pixels at one offset between the windows and then adding the change in this number as one of the windows is translated across the other. The scan-lines and columns of the windows are run-length encoded. Now, the change in the number of matching pixels can be attributed solely to the right-hand pixels of the runs of one of the windows. Furthermore, this change increases or decreases only when these right-hand pixels cross over the left-hand pixels of the runs of the other window; this speeds up the computation.

3. RESULTS AND CONCLUSIONS

These concepts have been implemented in a preliminary fashion by Leberl. We have implemented the algorithm fully. We have also applied the Marr-Hildreth operator to the windows of the master image, that are to be matched, instead of the entire image. We have registered an ERS-1/2 tandem pair of images (Fig. 1) using this algorithm to find the corresponding pairs of points in the images. A low value (sigma = 1) for the standard deviation of the Gaussian function in the Marr-Hildreth operator works well. Since matching with sub-pixel precision is necessary for the registration of interferometric images, we have interpolated the number of matching pixels (for various offsets between the windows) using cubic B-splines to achieve sub-pixel precision. The interferogram that we have thereby obtained (Fig. 2) is comparable to that obtained using cross-correlation (Fig. 3).

REFERENCES

Leberl, F.W., 1990. *Radargrammetric Image Processing*, Artech House, Massachusetts, pp. 250-259.

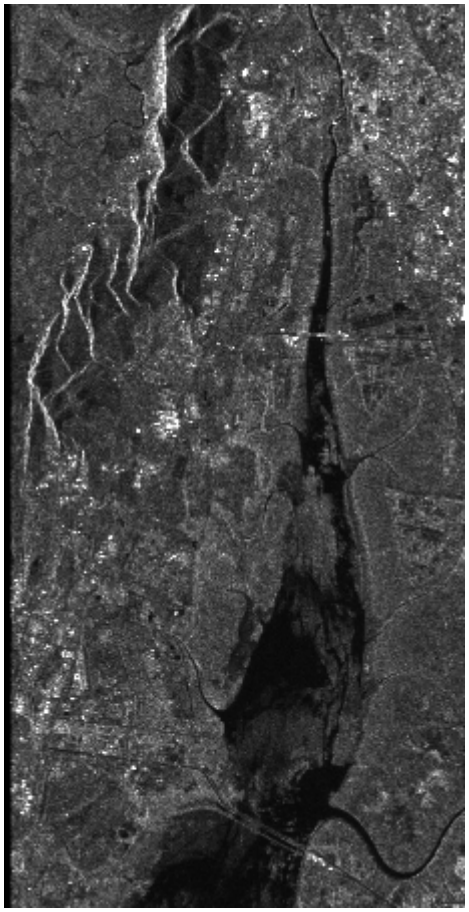

Fig. 1a: ERS-1 Image 1

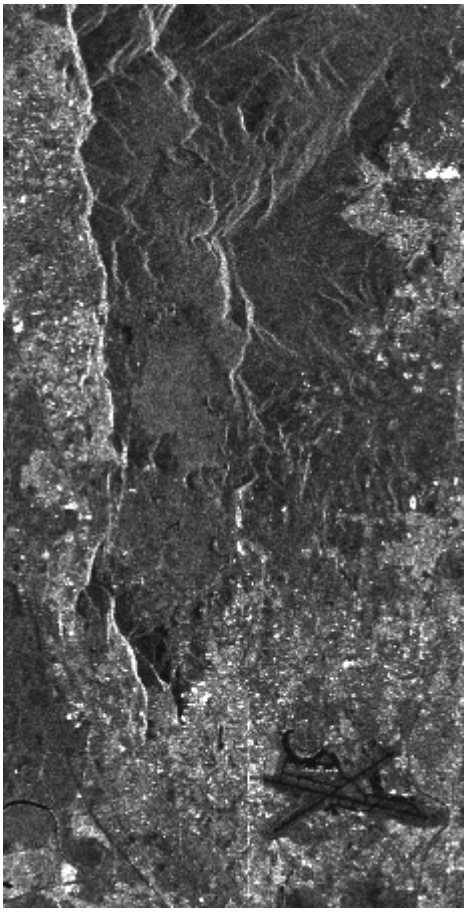

Fig. 1b: ERS-1 Image 2

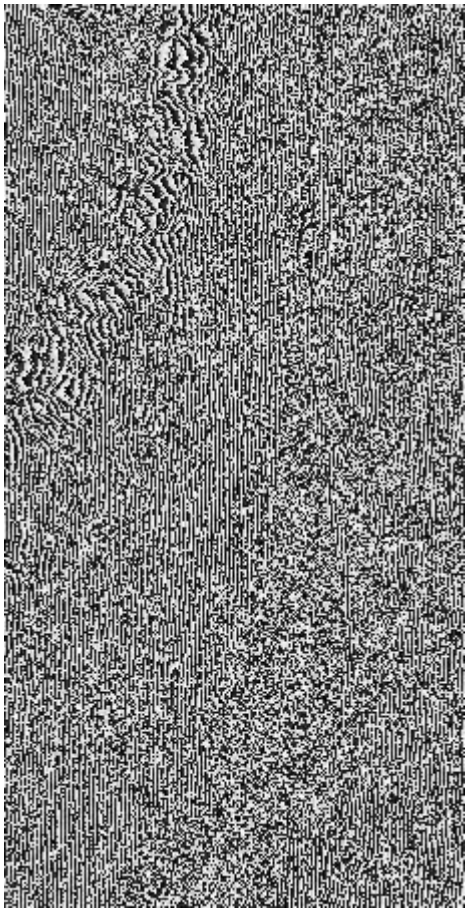

Fig. 2a: Fringe Pattern, corresponding to the image in Fig. 1a, obtained using the Marr-Hildreth algorithm.

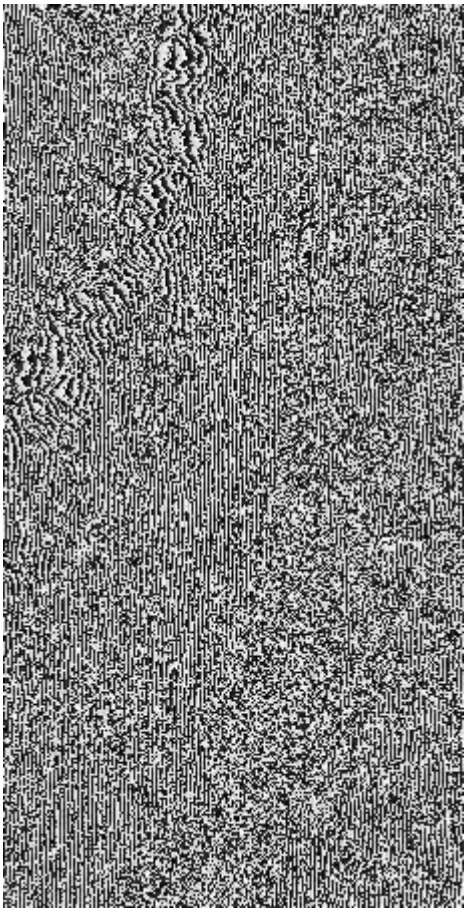

Fig. 3a: Fringe Pattern, corresponding to the image in Fig. 1a, obtained using Cross-correlation.

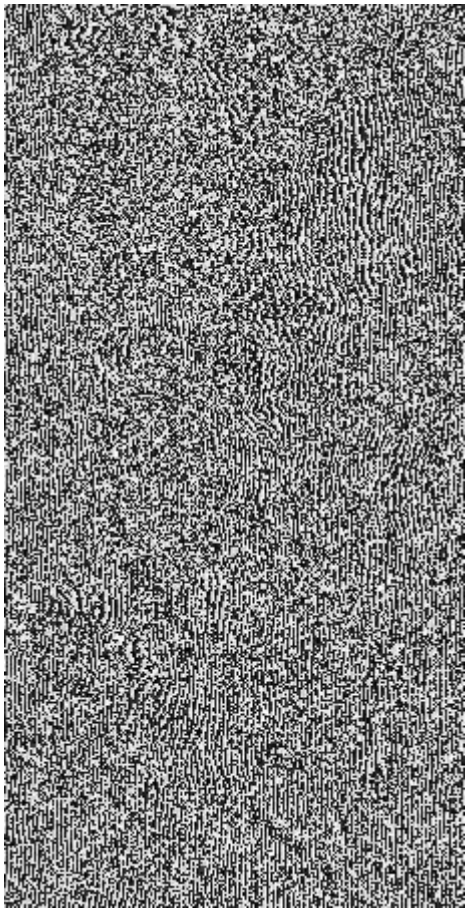

Fig. 2b: Fringe Pattern, corresponding to the image in Fig. 1b, obtained using the Marr-Hildreth algorithm.

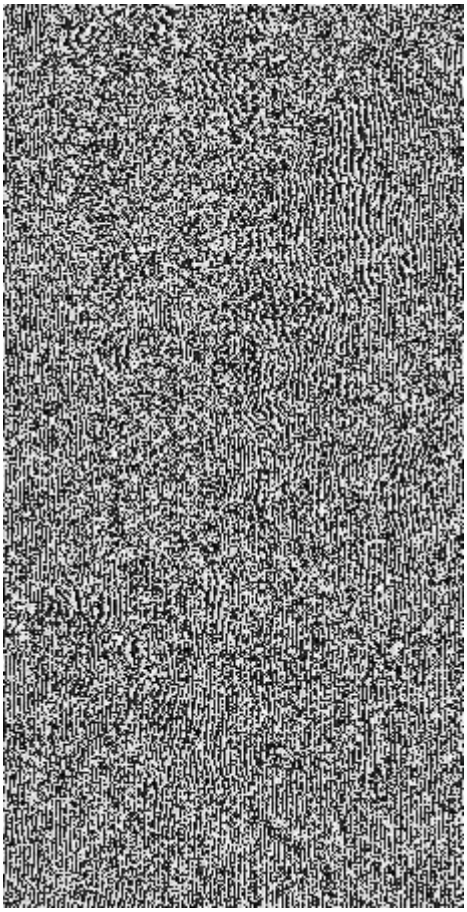

Fig. 3b: Fringe Pattern, corresponding to the image in Fig. 1b, obtained using Cross-correlation.