UNSUPERVISED SEGMENTATION OF AGRICALTURAL REGIONS USING TERRASAR-X IMAGES

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1. INTRODUCTION

TerraSAR-X is a new German radar satellite. It carries a high frequency X-band at 9.65 GHz Synthetic Aperture Radar (SAR) sensor that can be operated in different modes and polarizations. TerraSAR-X provides high resolution SAR images for detailed analysis as well as wide swath data whenever a larger coverage is required. Imaging is possible in single, dual and quad-polarization. The high resolution data of the new SAR sensors like TerraSAR-X increase dramatically the level of visible details in the SAR images. The high resolution enables to derive meaningful texture measures. The data furnished by TerraSAR-X allow studying microstructures in detail as well as analyzing surface formations and land use. In this extensively cultivated region, which besides is of great geological interest, the radar data supplied by TerraSAR-X will be an important source of information for analysis as well as for agricultural utilization improvement.

The image used is a part of Noerdlinger region situated in the middle of the Swabian Jura in Germany and published by the German Aerospace Center (DLR; date: July 1, 2007, 23:00 UTC; original resolution: 1 meter (reduced image); mode: high resolution spotlight mode; polarization: HH; dimensions: 3543x1506 in pixel size). At its centre stands the town of Noerdlinger, surrounded by fields which are cultivated.

The framework of this study is focused on automatic fast recognition of agricultural interest for TerraSAR-X images. The intended goal is to label regions in an image as fast as possible, into classes significant for a given application, like crop classification. First, a filtering technique is applied to obtain the restored image. Then, two different methods of unsupervised segmentation are used. The Otsu's method which is based on the optimum threshold of histogram [1] and the k-means method which is based on the Euclidean distance [2].

2. FILTERING

One of the major problems hampering the derivation of meaningful texture information from SAR imagery is the speckle noise. It overlays "real" structures and causes gray value variations even in homogeneous parts of the image. A filtering is therefore absolutely necessary in order to be able to identify image segments representing real structures on ground. After filtering the structured parts of the image can be much better separated. We have used different filters, like Kuan [3], Lee [4], enhanced Lee [5], Frost [6], enhanced Frost [5], Sigma [7], Gamma [8] and TSPR [9].

3. UNSUPERVISED SEGMENTATION

The unsupervised segmentation classifies the image automatically using a certain criterion. The Otsu's method detects the optimum threshold of histogram and separates the image in two regions of interest (two labels). The k-means method is used to separate the image in three regions of interest (three labels). It is assumed that we know that there are three groups of points but that we don't know the positions of the centers of the groups. The ''shortest distance to center'' decision rule (squared Euclidean distance) is used to find the correct centers and to label each point of group. We begin with a part of bright and dark crops of the initial image which has dimensions 236x236 in pixel size and after despeckling using one of the upper filters we apply the segmentation method. We can see the results after a filter TSPR (7x7) in figure 1.

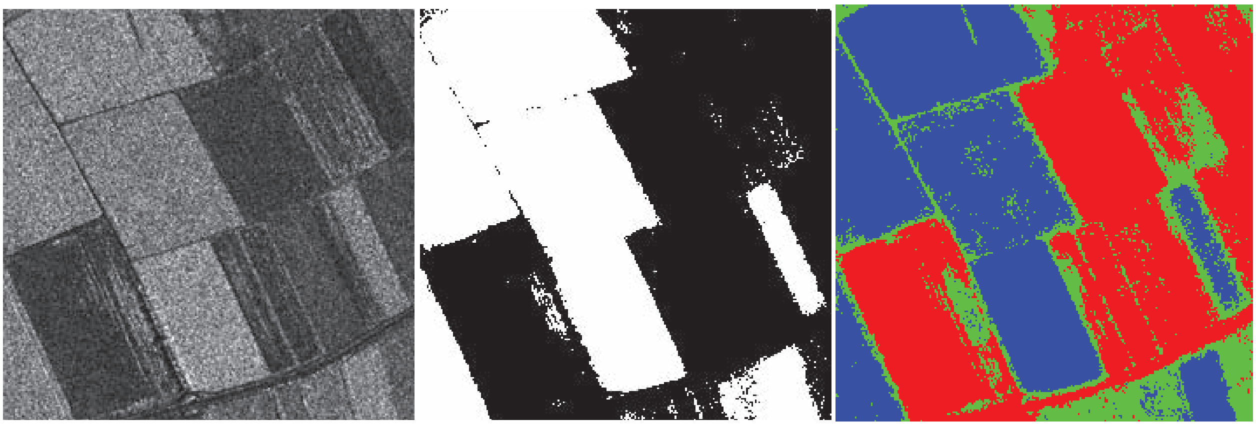

Figure 1: **a:** Initial image **b:** Segmented image after Otsu's method **c:** Segmented image after k-means method

4. CONCLUSIONS

Some methods are better to preserve the edges (Kuan, Lee, enhanced Lee) and some others are better to give compact regions (Frost, enhanced Frost, Sigma, Gamma, TSPR). The filter TSPR as a first stage gives one of the best segmentation results.

5. REFERENCES

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