AN UNSUPERVISED CLASSIFICATION USING AGGLOMERATIVE HIERARCHICAL CLUSTERING, WISHART TEST STATISTIC AND THE C-P DECOMPOSITION FOR FULLY POLARIMETRIC SAR DATA

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1. INTRODUCTION

A new unsupervised classification algorithm is introduced for fully polarimetric SAR data. The agglomerative hierarchical algorithm and Wishart test statistics are used for the cluster segmentation, which includes the process of estimation the number of clusters. The Cloude-Pottier decomposition & HSI color transform are used for the target identification, which also automatically render the colormap of the resulting images.

2. BACKGROUND

Since the fully polarimetric satellite SAR systems were launched successfully, unsupervised terrain classification using fully polarimetric SAR data becomes one of the important topics of the land use and land cover applications. Usually, the unsupervised classification for fully polarimetric SAR data is given in 2 stages, ex. the well known Wishart H/alpha/A classification [1]. For the 1st stage, it uses decomposition algorithms for the initialization to get initial clusters corresponding to different scattering mechanisms. For the 2nd stage, it uses merging algorithm, for example Wishart ML clustering, to refine the boundaries between different clusters.

The general POLSAR classification procedure may have a problem: the scattering mechanisms corresponding to the clustering results in the 2nd stage may change significantly compared to the scattering mechanisms of clusters corresponding to the initialization results in the 1st stage, so actually, it is difficult to use the decomposition results for the target identification analysis. Lee et.al. [2] introduce an algorithm which partial solve this problem. In this algorithm, the POLSAR data are firstly box-segmented into three categories. Each of the categories corresponds to one main scattering mechanisms (double bounce, single bounce, and volume scattering). Then, the initialization & clustering is performed within each of the categories. This method can keep three main scatting mechanisms through the whole classification process, but is not able to keep the scattering mechanisms for each of the clusters.

3. PROPOSED METHOD

For our point of view, the best way to solve this problem is to separate the identification procedure of scattering mechanism from the clustering procedure, and perform each of the procedures independently. The main idea is to build the POLSAR classification in 2 successive procedures. Firstly, we use the segmentation/merging algorithms to separate the POLSAR data set into clusters. The general segment & merging algorithms can be used in this procedure, and the clustering results should be only dependent on the inner structure of the POLSAR data set. Secondly, we use the decomposition algorithm to analyze scattering mechanisms of the clustering results. It should be notice that the decomposition algorithm is only used for the target identification, and no segmentation/merging procedure is needed.

4. CLASSIFICATION SCHEME

The whole classification scheme is given in the following (Fig.1), which contains 2 successive procedures, Proc I and Proc II.

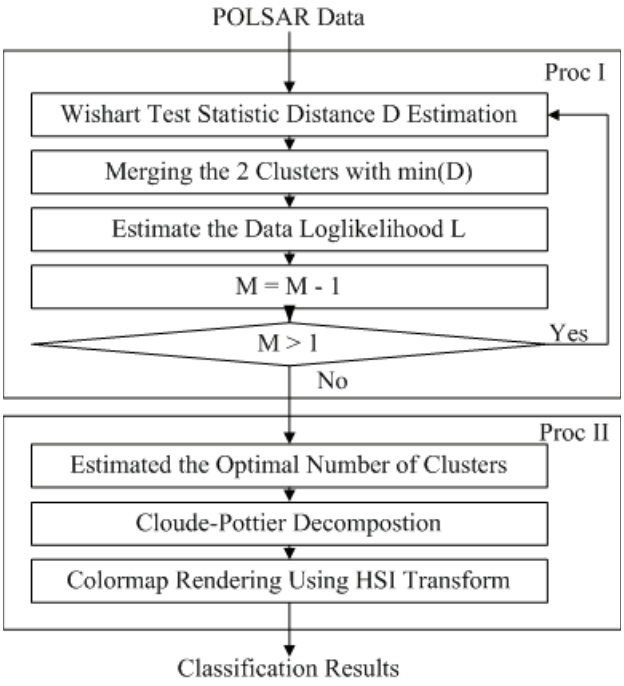

Figure 1. The proposed classification scheme

Proc I:

Here the agglomerative hierarchical algorithm is chosen as the clustering algorithm, and the clustering is performed iteratively from a very high number of clusters (can be equal to the number of pixels in the image) to 1. During each of iteration, the Wishart test statistic [3] is used as the distance function to estimate the dissimilarity

between 2 different clusters, and the 2 clusters with the minimum distance are merged together. A validation function is also provided according to the data log-likelihood [4], in order to estimate the optimal number of clusters from the POLSAR data inner structure.

Proc II:

In this procedure, an estimation algorithm is proposed for the data log-likelihood validation function to get the optimal number of clusters. Then, the Cloude-Pottier decomposition algorithm is performed on the averaged coherency matrix of each cluster centers, to identify different scattering mechanisms for each of the clusters, and the HSI transform is used for the automatic colormap rendering of the final classification results.

5. CONCLUSIONS

An unsupervised classification method is proposed for fully polarimetric SAR data. The main point is to separate the clustering procedure from the polarimetric target decomposition procedure, and use the decomposition results directly for the target identification. The effectiveness of the classification algorithm is demonstrated using fully polarimetric space borne data sets (ALOS/PALSAR, RADARSAT-2).

6. ACKNOWLEDGMENT

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7. REFERENCES

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