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RESEARCH ARTICLE

IMAGE SEGMENTATION USING HYBRID CORRELATION CLUSTERING

*Deepa, R. and Dr. M. P. Indra Gandhi

Department of Computer Science, Mother Teresa Women's University, Kodaikanal-624101

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ABSTRACT

In this paper, image segmentation is based on hybrid correlation clustering. Correlation-clustering is a graph-partitioning algorithm used in natural language processing, document clustering and image segmentation. In this proposed method the hybrid correlation clustering improves the performance and accuracy of the existing higher-order correlation clustering. First apply the higher-order correlation clustering over Hypergraph, S-SVM, and combine the difference of existing and proposed algorithms. Experimental results on SBD dataset shows that the proposed method allow to archieve state-of-the-art results with a simpler and efficient model than the previous work.

INTRODUCTION

Image segmentation is the process of partitioning a digital image into multiple segments i.e, set of pixels, pixels in a region are similar according to some homogeneity criteria such as color, intensity or texture, so as to locate and identify objects and boundaries in an image. Segmentation is also useful in Image Analysis and Image Compression. There are many different techniques available to perform image segmentation. Clustering is the task of partitioning data points into groups based on similarity. Clustering techniques commonly used in machine learning and datamining. Correlation clustering (Bansal *et al.,* 2004) is the graph partitioning algorithm that maximizes intra cluster similarity and inter cluster dissimilarity. Previously hypergraph is formulated. Hypergraph is a generalization of a graph in which an edge can connect any number of vertices. Formally, a hypergraph is a pair where is a set of elements called nodes or vertices, and is a set of non-empty subsets of called hyperedges or edges. LP relaxation is generalized for hypergraphs. Obtaining the unsupervised multiple partitioning by merging superpixel, the obtained regions are used to defining the hypergraph edges. Then LP relaxation is used to approximately solve the higher-order correlation clustering problem and supervised training of the parameter vector by using S-SVM. By applying decomposable structured loss function to handle balanced classes. To incorporate loss function into the cutting-plane procedure for S-SVM training. The proposed H-CC alleviates all the difficulties of HO-CC.

Corresponding author: Deepa, R.
Department of Computer Science, Mother Teresa Women's University, Kodaikanal-624101

Combining the two different methodology the experimental result obtaining the improved and high-level accuracy while comparing the existing higher-order correlation clustering.

Previous work

Higher-Order Correlation Clustering over Hypergraph: Linear discriminant function is formulated for measuring the homogeneity. It is decomposed into two terms by assigning different parameter vector. HO-CC (Kim *et al.,* 2011), (Kim *et al.,* 2014) considers a broad homogeneous region reflecting the higher order relation among the superpixels. unsupervised multiple partitioning by merging superpixel, the obtained regions are used to defining the hypergraph (Berge, 1989) edges. Using the unsupervised multiple partitioning for defining the higher-order edges.

LP relaxation for higher-order correlation clustering: Higher-Order edges places in different cluster, when all pairwise edges of a set of superpixels in same cluster, then the higher-order edge of the set placed in one cluster. Then LP relaxation is used to approximately solve the higher-order correlation clustering problem. The exponentially large number of constraints use the cutting plane algorithm (Wolsey, 1998).

Feature vector: It is used to concatenate visual cues with different quantization level and thresholds. The pair wise feature vector shows the correspondence between the superpixels and it has the features such as color difference feature, texture difference feature, shape/location difference feature (Hoiem *et al.,* 2007), edge strength feature (Arbelaez *et al.,* 2011), joint visual word posterior feature. Higher-order feature vector is used to characterize the most complex relaxation among superpixels to measure the homogeneity. It has variance feature, edge strength feature, template matching feature. The similarity or homogeneity can be either positive or negative.

Structured Support Vector Machine

The S-SVM offers good generalization ability and flexibility for choosing any label loss function. Cutting plane algorithm (Tsochantaridis *et al.,* 2005) is used to solve the optimization problem of S-SVM.

MATERIALS AND METHODS

In this paper the proposed methodology has new technique to improve the efficiency and accuracy. This approach has following processes

Ground truth of image: Find the ground truth of original images using the discriminant function. It is used to find the similarity or homogeneity of various images.

Find the difference of the HO-CC segmented image and the ground truth image. Combining the segmented image difference and ground truth image difference. Calculate the true positive, true negative, false positive, false negative to calculate the precision and recall values.

$$P = \frac{tp}{(tp+fp)} \qquad R = \frac{tp}{(tp+fn)}$$

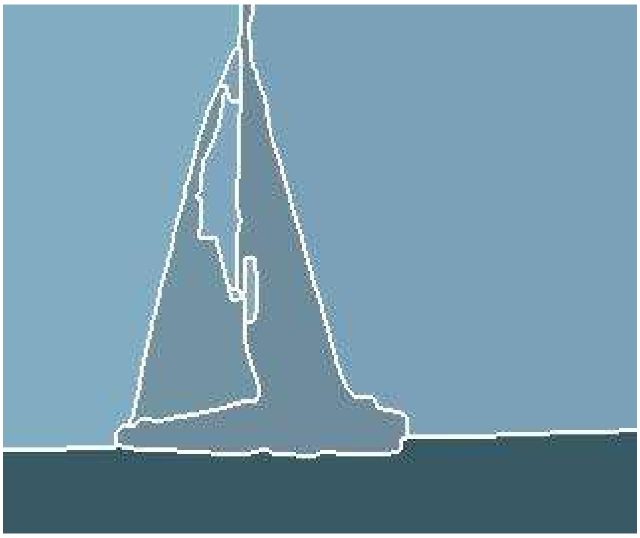
P represents precision and the R represents recall. Calculate the F score value.

$$F = 2 \times \frac{PR}{P+R}$$

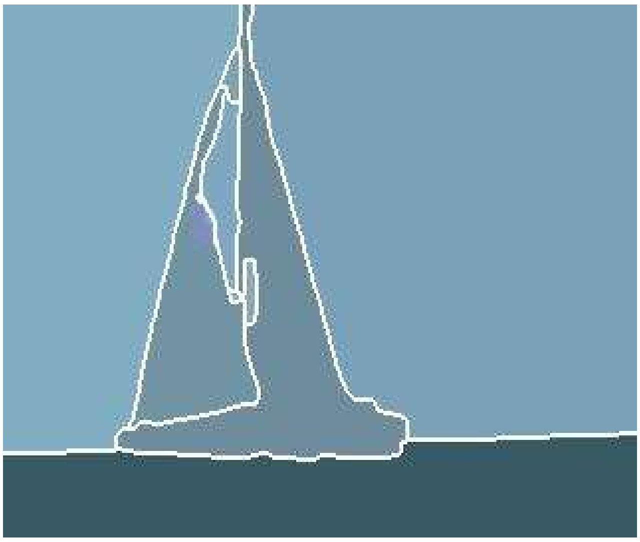
Precision, recall and F score ranges between 0 and 1 indicating bad or good segmentation, respectively.

EXPERIMENTAL RESULTS

(a)

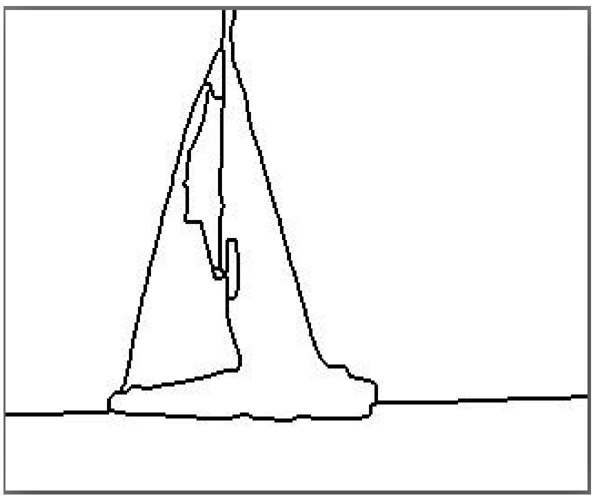


(b)

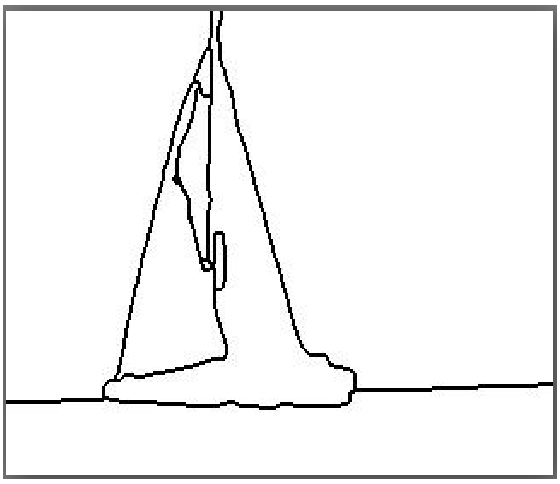


(c)

Figure 1. (a) Original image, (b) Segmented image, (c) Groundtruth image



(a)



(b)

Figure 2. (a) Segmented differnce, (b) Groundtruth difference

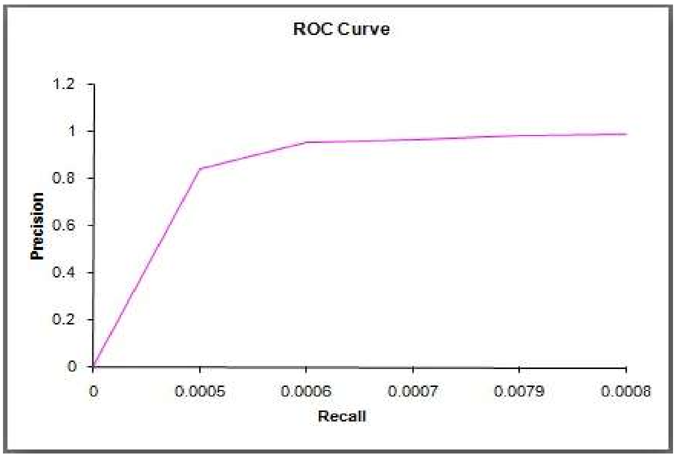


Figure 3. ROC Curve

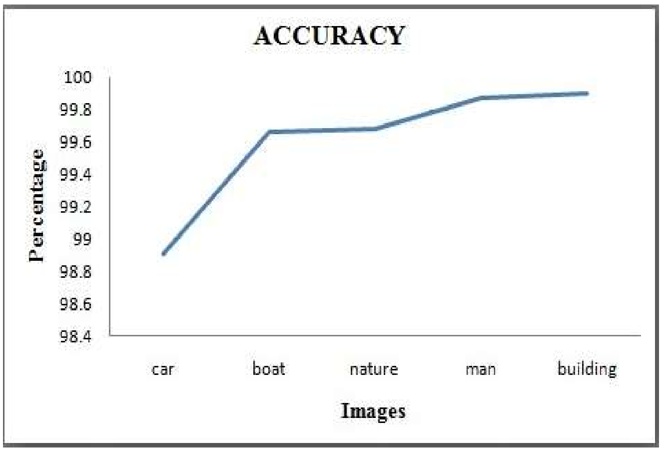


Figure 4. Accuracy

Existing Work

Table 1. F-measure for HO-CC

DATASET IMAGE	F-MEASURE
Boat	0.730

Proposed Work

Table 2. F-measure for H-CC

DATASET IMAGE	F-MEASURE
Building	0.982

The proposed hybrid correlation clustering shows the accurate results of the images. Comparing with existing HO-CC has medium level of accuracy. Hybrid correlation clustering has high level accuracy. Applying this technique with different images, building image has the high accuracy rate (99%), Using the proposed methodology table-2 shows the F-measure value ranges from 0.9557 to 0.9823, the existing HO-CC has 0.730 is a medium level value. Using this methodology the performance, F-score and accuracy level has improved in the proposed work.

Conclusion

The proposed hybrid correlation clustering uses the ground truth calculation to find the difference of ground truth images. Applying hybrid methodology between the segmented image difference and ground truth image difference it shows the high performance than the existing HO-CC. It is useful in satellite imaging, military and other image applications.

Future scope

The proposed framework applicable for variety of other areas and also improve the quality and other features of image for various fields.

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