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A STUDY OF IMAGE SEGMENTATION AND CLASSIFICATION BASED ON PLANAR GRAPH AND NEIGHBORHOOD SPANNING TREE

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ABSTRACT:

In the image processing literature, texture is usually defined in terms of the spatial interactions between pixel values. The aim of texture analysis is to capture the visual characteristics of texture in an analytical form by mathematically modeling these spatial interactions. This allows segmentation of an image into its various textural components, with each component being classified according to how well it fits the mathematical model of a particular texture. This approach requires the number and type of training data sets are used to formalize the criteria by which the texture models become unique from each other, but not necessarily unique from any other textures not included in the training set. If a texture is to be recognized in a scene containing previously unseen textures, then a new approach is required. The texture models need to capture more than just the characteristics required to distinguish one texture from other known textures they need to capture all the unique characteristics of that texture. This chapter describes a new method for image segmentation by generating binary random values in the image based on neighborhood spanning tree. This method has produced better result than conventional region based segmentation methods for complex multi resolution images. Image segmentation is essential preliminary step in most automatic pictorial pattern-recognition and scene analysis problems. Image segmentation is one of the most important steps leading to the analysis of processed image data. Its main goal is to divide an image into parts that have a strong correlation with objects. This chapter describes the generation of random fields for image segmentation based on spanning tree.

KEYWORDS: Image Segmentation, Planar Graph, Spanning Tree,image processing.

INTRODUCTION:

In many fields of research, objects and interrelations are represented by graphs. Proximity graphs are those in which points are fixed in **n**-dimensional space and adjacency is determined by the closeness of a pair of points relative to other points in the set in. These graphs are useful in solving problems in many areas of mathematics and computer science including computational geometry, geographic connectivity analysis, pattern analysis, artificial intelligence, and computer vision. As for structural relations, in numerous situations, graphs have turned out to provide the most appropriate tool for setting up the mathematical model. This is certainly one reason why graph theory has expanded so rapidly during the past decades. The idea of looking at a family of sets as a generalized graph took shape around 1960. By regarding each set as a *generalized edge* one obtains a structure called a *hyper graph*. Hyper graph theory has proved to be extremely useful for solving numerous applications in several fields of human activity. It is thus natural to use this combinatorics tool in image processing. Such a general frame provides a new basis for models in different areas such as segmentation, restoration, and coding.Graphs are mathematical objects that can be used to model networks, data structures, process scheduling, computation, and a variety of other systems in which the relations between the objects in the system play a dominant role. Hyper graphs generalize the concept of a graph in order to cope with additional combinatorial problems. Our objective in this section is to introduction the terminology of graph and hyper graph theory and to define some familiar classes of graphs.

ELEMENTARY GRAPH THEORETIC DEFINITIONS:

In the past quarter century one can see a remarkable rise of graph theory as an important area of mathematics. This theory can be seen as a unified framework for many problems in different fields such as traffic networks, electrical circuits, and biology. It would be difficult to give a complete account of the area of graph problems. There have been several good accounts in the literature. Present purpose for this study is to give an overview of graph theory.

A *graph* is a couple G=(V;E), where V is a set of elements called *vertices,* and E is a set of unordered pairs of members of V called edges. Given a graph G, denote by $\Gamma(x)$

the *neighborhood* of vertex x, i.e., the set formed by all vertices adjacent to x :

$$\Gamma(x) = \{y \in V, \{x, y\} \in E\}.$$

The number of neighborhood vertices x if the *degree of x* (we write *dx*). A graph is *loopless,* if it does not contain an edge of type (x,x). If *dx* is constant, the graph is called regular.

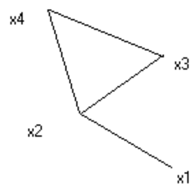


Fig. 1. Example of graph G.

Fig. 1. for a geometric presentation of a graph G. The vertices of the graph are shown as points, while the edges are shown as lines connecting pairs of points.In this graph the set of vertices is V= {x_1, x_2, x_3, x_4}, the set of edges is E_1={x_1, x_2}, E_2={x_2, x_3}, E_3={x_3, x_4}, E_4={x_2, x_4}, the neighborhood of x_2 is $\Gamma(x_2) =${x_1; x_3; x_4}, and the degree of x_2 is $dx_2 = 3$.

PROPOSED METHOD:

In this study a new algorithm is proposed to segment the image into regions by generating binary random fields based on neighborhood spanning trees [161,162] and planar graphs.A graph G is an order triple (V (G), E (G), Φ) consist of a non-Empty set. V is called the set of vertices (nodes, points) of the graph, E is said to be the set of edges of the graph and Φ is a mapping from the set of edges E to a set of order or unordered pairs of elements of V.The most common representation of a graph is by means of a diagram in which the vertices are represent as points and each edge as a line segment joining its end vertices any pair of vertices which are connected by an edge is a graph is called adjacent vertices. Planar graph is one of the most important graphs for image segmentation. A graph G is said to be planner, if it can be drawn in the plane without its edges crossing. Otherwise G is not a planar graph. A planar graph divides the plane into regions. A region is characterized by the cycle that forms its boundary of their regions are connected portions of the plane.Two types of planar graphs are, one is open planar graph and another is closed planar graph. Initial vertex is equal to final vertex then it is called closed graph. Initial vertex is not equals to final vertex then it is called open planar graph.

Spanning tree is graph without cycles. Our first theorem is known as Kircho's Matrix-Tree Theorem and dates back over 150 years. We are interested in counting the number of spanning trees of an arbitrary undirected graph G = (V,E) with no self-loops.

EXPERIMENTAL RESULTS:

The novel method for generation of binary random fields for image segmentation and boundary detection for image classification is compared with existing hyper graph method. But hyper graph method fail to detect outer edges of images and it cannot filter the noise for the small objects with over lapping; it produces thicker edges then novel method. Hyper graph theory fails to produce good boundaries for complex images. In this section various types of test images like Lena, S.V.Ranga Rao, Blood cells, Rocks and synthetic images with 10%, 20%, 30%&40% of Gaussian , speckle and standard deviation noises are considered. The experimental results are produced and global threshold values are given in table 1 and the graph is drawn. Under the visual perception the novel method produced better results than hyper graph method. As per the statistical estimation novel method gives better optimal results for synthetic noise images. Based on the results conclusions are made.

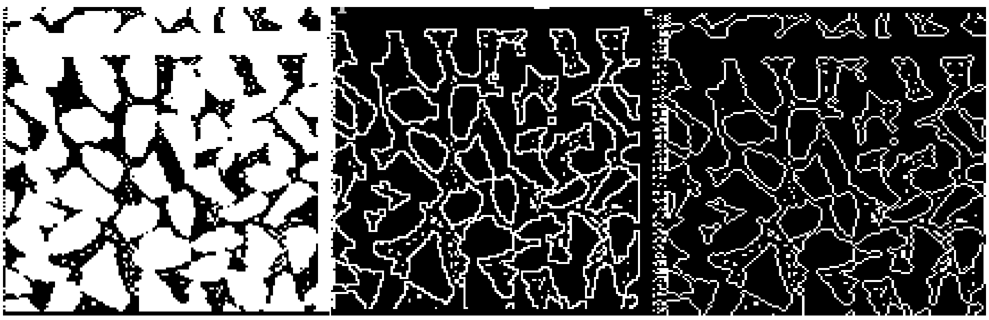
Results on Lena images

(a) Lena **(b) Hyper** **(c) Novel**

2 Results on S.V.Ranga Rao images

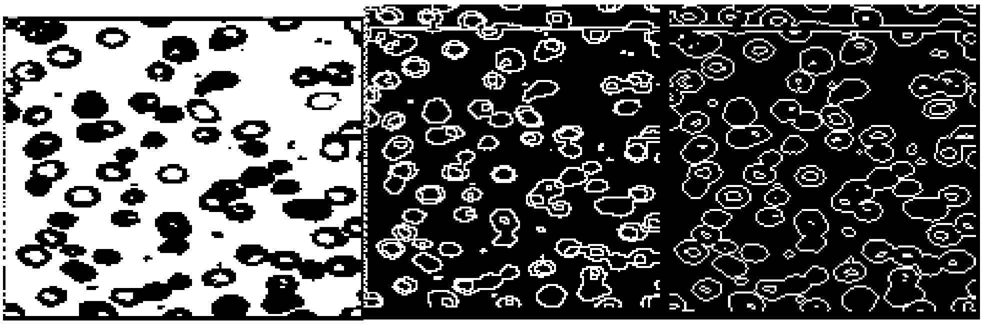
(a)S.V.Ranga Rao **(b) Hyper** **(c) Novel**

3 Results on Rocks images



(a) Rocks **(b)Hyper** **(c)Novel**

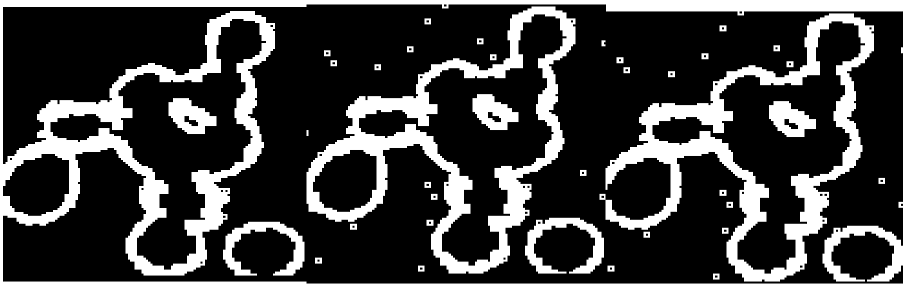
4 Results on Blood cells images



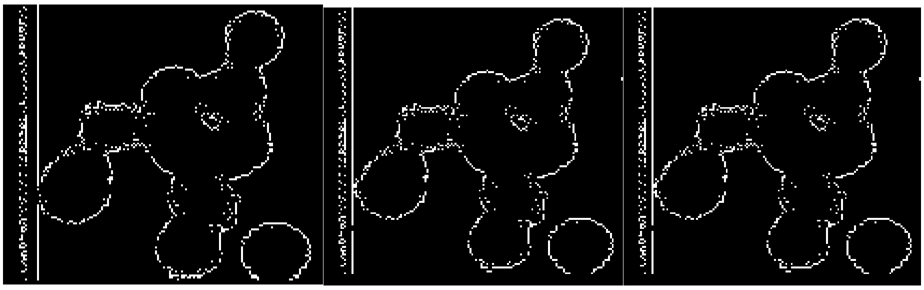
(a) Blood cells **(b)Hyper** **(c)Novel**

5 Original bmp image with Gaussian noise of 10%, 20%, 30%

(a)1g01 (b)1g02 (c)1g03

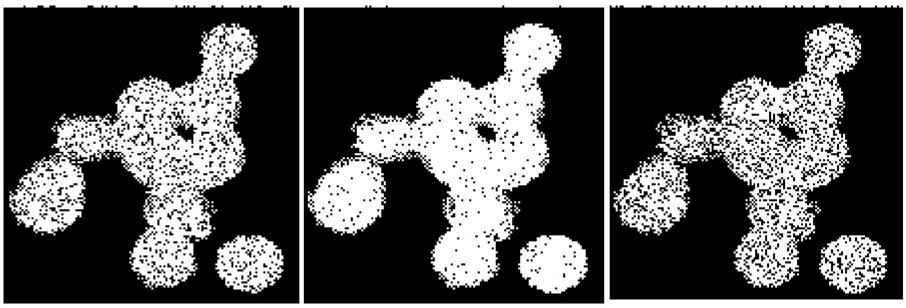


(d) Hyper1g01 (e) Hyper1g02 (f) Hyper1g03

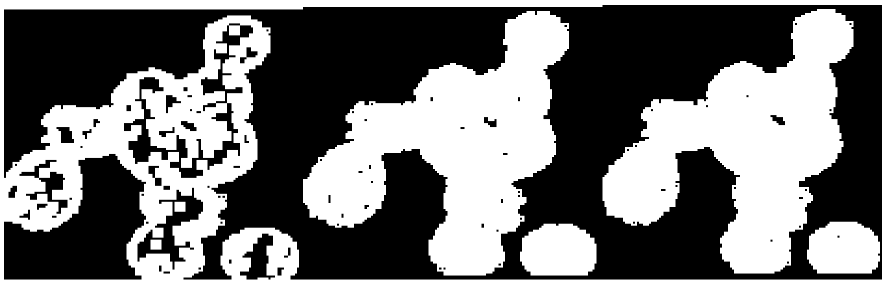


(g)Novel1g01 (h) Novel1g02 (i) Novel1g03

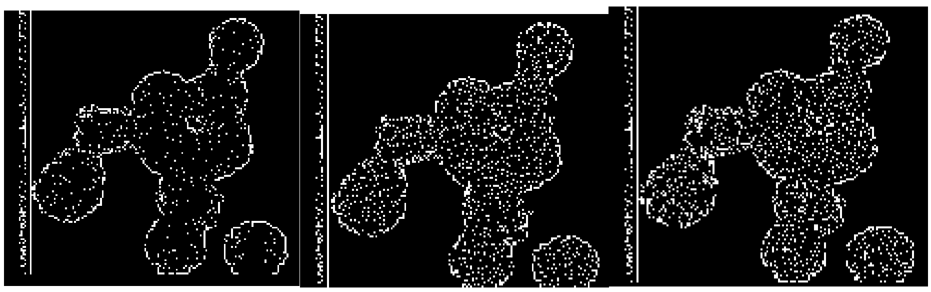
6 Original bmp image with speckle noise of 10%, 20%, 30%



(a) 1sp01 (b) 1sp02 (c)1sp03



(d) Hyper1sp01 (e) Hyper1sp02 (f) Hyper1sp03

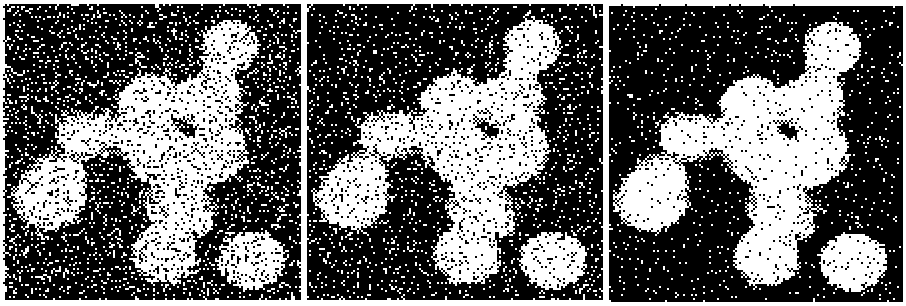


(g) Novel1sp01 (h) Novel1sp02 (i) Novel1sp03

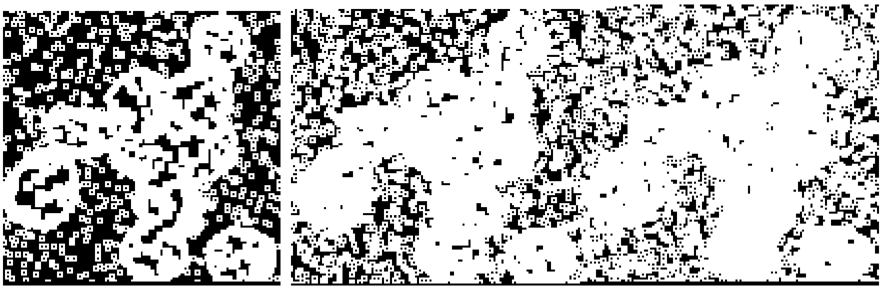
7 Original bmp images with speckle noise of 40%

(a) Novel1sp04 (original) (b) Hyper1sp04 (c) novel1sp04

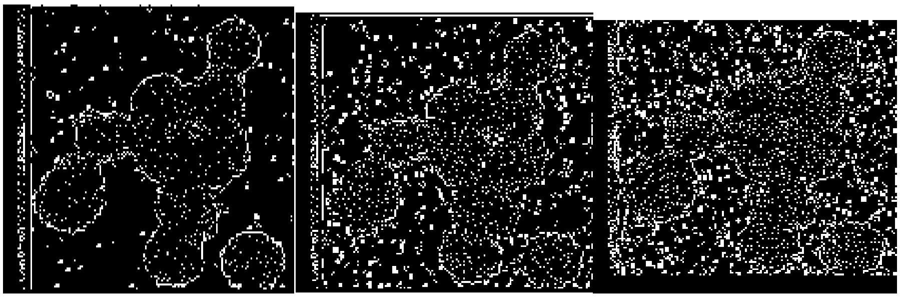
8 Original bmp image with standard deviation noise of 10%, 2 0%, 30%



(a) 1 st01 (b) 1st02 (c) 1 st03

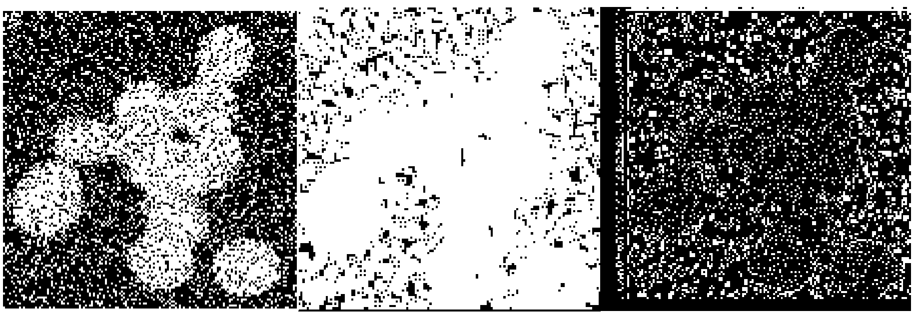


(d) Hyper1st01 (e) Hyper1st02 (f)Hyper1st03



(g) Novel1st01 (h) Novel1st02 (i) Novel1st03

9 Original bmp image with standard deviationnoise of 40%



(a) 1st04 (original) (b) Hyper1st04 (c) Novel1st04

IMAGES	HYPER	NOVEL
1g01	0.38	0.073
1g02	0.39	0.055
1g03	0.39	0.055
1sp01	0.33	0.065
1sp02	0.3	0.087
1sp03	0.29	0.1
1sp04	0.3	0.1
1st01	0.23	0.1
1st02	0.16	0.13
1st03	0.11	0.17
1st04	0.08	0.28

CONCLUSION:

The hyper graph method for integrating the outputs of all the weak frail and idiosyncratic segmenters to produce estimates of the true boundaries of images those are superior to the estimates available from any one alone. An important advantage of this approach is that it works in a much more general way than any of the individual segmenters and will not fail catastrophically as each of the individual segmenters must for one image type or another. As one segmenters fail, however, another one of the them succeeds. This is the essence of the success of the new method.

The cost of this integrated approach, of course, is an increased computational load expressed as prolonged processing times and increased storage requirements. However, these are only technical problems. The forthcoming availability of parallel processors, faster arithmetic units, fast algorithm, streamlined code, and increased memory size promise to alleviate these difficulties in the computer science domain. The vast storage capacity and the innate parallelicity of the organic brain mitigate this problem in the psychobiological domain. The hyper graph theory, allows using all the mathematical background of combinatorics.

The present study has advocated propositions for solving basic image processing problems such as segmentation deduced from this model. The main goal is not to optimize the performance of these algorithms, but only to suggest that this new approach can be effective approach to image processing. Through this application one can conclude that the hyper graph associated to an image lets one process a picture with very simple assumptions.The cost of the segmentation method using weak operators requires increased computational load and prolonged processing times and increased storage requirements. In future one can develop an algorithm to reduce the above complexities. Naturally the combinatory algorithm presented can be improved in several ways by using conditions for a hyper graph satisfy the Helly property, the uniformity criterion, adaptability, parameters and decision rules, etc,.

To overcome these draw backs, A new segmentation method has been presented by generating simple like binary random fields based on neighborhood spanning tree and planar graph. This new method gives accurate results for noise images. The table of values and graph shows that it is very useful for image classification by generating good boundaries. It opens many new possibilities for segmentation in unsupervised mode. This algorithm is simple enough for the user to perceive the results as immediate. Since a binary image may not contain enough information for many applications like satellite images and texture images.

The monochrome images show better information than binary images. Monochrome images are suitable to represent complex images. To overcome these drawbacks, in the next chapter we proposed a new water shed method for gray level image segmentation and classification.

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