Study on Energy Based Methods in Medical Image Segmentation

Ramgopal Kashyap
Ph.D. Scholar, AISECT University,
Bhopal (M.P.) India.

Pratima Gautam
Professor, AISECT University,
Bhopal (M.P.) India.

ABSTRACT

Segmentation is nothing but creation the part of image or any object. Pattern recognition and image analysis are the first step of image segmentation. In the computer vision field and image analysis we can done significant research topic in the segmentation of video with dynamic background.Image segmentation is most of moderator function in image processing and analysis. Medical image segmentation places a crucial role in different medical imaging application. Image segmentation is a process of partitioning a digital image into multiple segments. Segmentation makes the image into something, which are easier to analyse. Segmentation is needed in diagnosis, surgery preparation and other medical applications. Current segmentation approaches are reviewed and reveals its reward and drawback. Different segmentation methods are thresholding, region growing, clustering, artificial neural networks, deformable models, Markov random field models, deformable models, and wavelet. Using the different algorithms the current methodologies of image segmentation is reviewed so that user interaction is possible for images. In this paper, the review of image segmentation is explained by using different techniques. Index Terms— image segmentation, image analysis

I INTRODUCTION

Dynamic backdrop is done by using image segmentation of video. Segmentation of video with dynamic background has been an important research topic in intelligent surveillance and human-machine interface technologies [1]. For the segmentation we need the Images. But the images are either in form of black and white or color. Color images are due to the grey level [2]. As the grey level difference changes the color of color image also changes. Image segmentation plays important role in segmentation of medical images. Medical imagery play vital role in secondary health care which provides health care access patients for treatment. For the medical images, segmentation is crucial as a follows by first step in Medical Image Analysis (MIA) [3]. In image analysis appear errors as image measurement, image show and feature extraction. So that in case of medical image segmentation proper image segmentation is difficult because of size of the head,torce,leg,brain parts, type of bug etc are different. So for the segmentation of medical images we need different algorithms and dissimilar procedure to segment and classification of image. However, depending on the knowledge of radiologist, he can consume time for studying medical images which depends on visual explanation. Segmentation techniques can be stated as the methods that are used for extracting and representing the information from an image. The accuracy of segmentation is determined by the essential success or failure of computerized analysis process. A set of segments that together cover the entire image, or a set of contours extracted from the image is the effect of image segmentation. Each of the pixels in a region is alike with respect to some characteristics or calculates property such as color, intensity or texture. When applied to a stack of images, typical in medical imaging, the ensuing contours after image segmentation can be used to create 3D rebuilding with the help of interpolation algorithms like marching cubes. There are so many requests for image segmentation. The main practical applications include content based image retrieval, Machine vision, Medical Imaging, Object detection, Pedestrian detection, Face detection, Brake light detection, Locate objects in satellite images, Recognition Tasks, Iris recognition, Traffic control systems. The main applications of medical imaging are Locate tumours and other pathologies, Measure tissue volumes, Diagnosis & study of anatomical structure. This paper provides an overview of methods used for medical image segmentation.

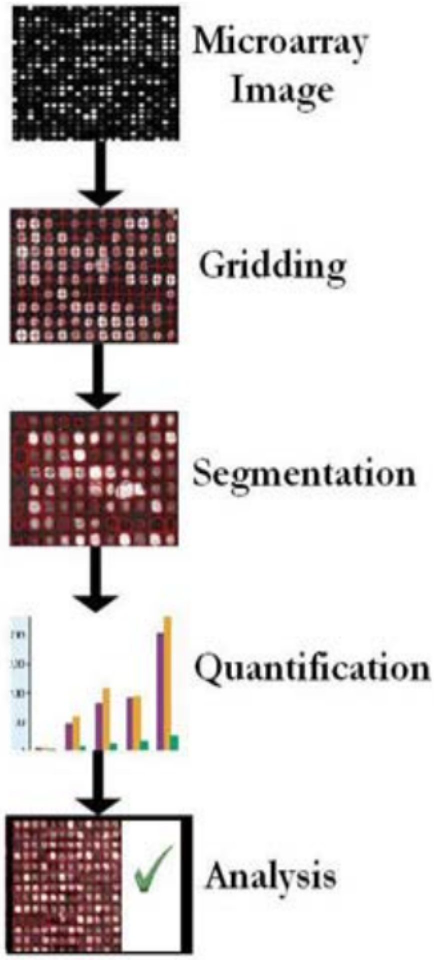

Fig. 1 Steps of Microarray Image Analysis Process.

II LITERATURE SURVEY

Method based on image segmentation evaluation techniques [3]; they are categorized into two types: Categorization and association. Characterization may be seen as a process while comparison technique as an inter-technique one. Based on different technologies, image segmentation [3] approaches are currently divided into following categories, based on two properties of image. A. Detecting Discontinuities The edge detection requires the detecting discontinuities property which includes image segmentation algorithm. Intensity [6] of the image is changed and partitions an image. Edge detection is the segmentation by finding the pixels [7-8] on the region boundary. Edge can be described by the boundary between the adjacent parts of an image [9]. B. Detecting Similarities It means to partition an image into regions that are similar according to a set of predefined criterion [5]; this includes image segmentation algorithms like thresholding, region growing, region splitting and merging.

This section describes several common approaches that have appeared in the recent literatures on medical image segmentation. Each method describes the overview of how it is implemented and also its advantages and disadvantages. Each technique is described separately, different methods can be used together to solve a particular problem [5-6].

Different segmentation methods described in this paper are thresholding approaches, region growing approaches, clustering approaches, deformable models, Markov random field models, multi-agent system approach, and wavelet segmentation.

(a) Thresholding

This is the simplest method of image segmentation. Tresholding is used to create binary image based on intensity of the image. This method attempts to find an intensity called threshold. This technique to partition an input image into two or more pixel value by comparing with the predefined threshold value T [1]. Let I(i,j) be an image, 0 p(i,j) < T

I(i,j) = *1 P(i,j) > T*

Where p(i,j) refers to the pixel value at position (i,j). thresholding can be either locally or globally. Global thresholding partitions the image into two based on the above equation. In local thresholding image is divided into sub images and thresholding properties are derived from the local properties of its pixels. The disadvantages of this methods are difficulty in finding the threshold value, in its simplest form two classes are generated and it cannot be applied to multiple channel images, thresholding does not take into account the spatial characteristics of the image. This causes it is sensitive to noise and intensity inhomogenity, which can occur in magnetic resonance images. Corrupt the histogram of the image, cause the separation more difficult [1].

(b) Region Growing

Region growing is a widely used segmentation technique. Region of an image is connected based on some criteria. These criteria can be intensity information or edges in the image. Region based segmentation is partitioning of an image into similar areas of connected pixels based on some criteria [7]. This technique requires a seed point selected by the operator and extracts the pixels connected to the initial seed with the same intensity value. Te problems of discontinuous edges and no segmentation of objects without edges are eliminated. Its main disadvantage is that manual interaction is needed to obtain the seed point. A seed must be planted for each region to be extracted. This method can be sensitive to noise, so the extracted region may have holes or it may be disconnected.

(c) Clustering

This method is termed as unsupervised method because it does not use the training data. Clustering method train themselves using the available data. Tree commonly used clustering algorithms are K-means clustering, fuzzy e-means algorithm and expectation minimization (EM) algorithm. K-means clustering algorithm clusters data by iteratively computing a mean intensity for each class and segmenting the image by classifying each pixel in the class with closest mean. Fuzzy e-means algorithm allows soft segmentation based on fuzzy set theory. tial modelling. So it is sensitive to noise and intensity inhomogenities.

(d) Deformable Models

These are physically motivated, model-based techniques for delineating region boundaries using closed parametric curves or surfaces that deform under the influence of internal or external influences [2]. A closed curve or surface must be placed near the desired boundary and then allowed to undergo an iterative relaxation process. This help to delineate an object boundary in an image. Internal forces are found from within the curve or surface to keep it smooth throughout the deformation. External forces are usually computed from the image to derive the curve or surface towards the desired feature of interest. The main advantage of this method is their ability to directly generate closed parametric curve or surfaces from images and their incorporation of a smoothness constraint that provides robustness to noise and spurious edges [11]. Disadvantage of this model is that it requires manual interaction to place an initial model and select appropriate parameters.

(e) Markov Random Field Models

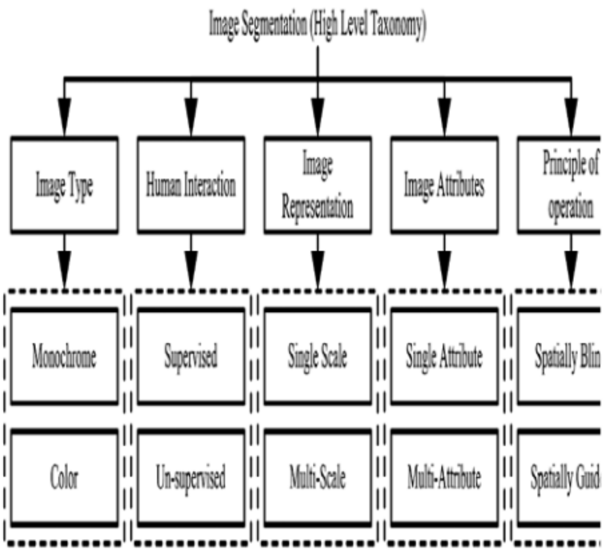

Fig.2 High Level Taxonomy Classification of segmentation

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Markov Random field Models (MRF) itself is not a segmentation method but a statistical model which can be used within segmentation methods. Here specifies the spatial interaction between nearby pixels. These interactions provide a mechanism for modeling a variety of image properties. In medical imaging they are typically used to take into account the fact that most pixels belong to the same class as their neighboring pixels [4]. MRF incorporated into clustering segmentation algorithm such as K-means algorithm. The segmentation is then obtained by maximizing the posteriori probability of the segmentation given the image data using iterative method such as iterated conditional models or simulated annealing. The disadvantage of MRF models is the proper selection of parameters of controlling the strength of spatial interactions. Here loss of important structural details occurs. This method also require computationally intensive algorithm. Despite these difficulties, MRF are widely used not only to model segmentation classes, but also to model intensity inhomogenities that can occur in magnetic resonance images.

III SPATIALLY GUIDED APPROACHES

In contrast to spatially blind methods, spatially guided approaches, as the name suggests, are guided by spatial relations of pixels for segmentation. Their primary objective is to form pixel groupings that are compact or homogeneous from a spatial point of view, irrespective of their relationships in specific feature spaces. region splitting is a technique that is initiated with an inhomogeneous

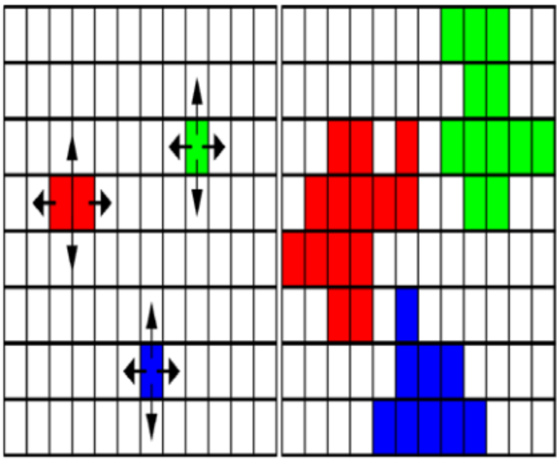

Fig. 3 Seed pixels (left) and region formed after a few iterations of growing (right).segmentation of an image, which is repetitively split until segments satisfying a particular homogeneity criterion are obtained.

Splitting can be achieved via diverse methods such as quadrature tree decomposition, watersheds, or implicitly via region growing when multiple seeds are placed in homogeneous areas that fall under different categories of our lowlevel taxonomy.Region-growing approaches. Fan proposed an automatic image segmentation algorithm that begins with an edge detection scheme, wherein the centroids between the detected edges are chosen as the set of candidate seed points. Subsequently, a growth procedure is utilized to spatially integrate pixels, in a recursive fashion, to an appropriately chosen seed from the entire set until the final segmentation is achieved, Region-merging approaches. Similar to growing, a significant number of approaches have been proposed that explicitly use a merging protocol for region-based segmentation.

Devaux built a unique segmentation architecture that employed the Karhunen-Loeve transform (KLT) in combination with color and textural attributes for regionbased segmentation of color aerial images. The algorithm separately exploited color and texture information to come up with two initial segmentation maps that are subsequently fused together in a merging protocol.Active contours. Within the notion of using edge/contourbased energy, curve evolution methods involving active contours better known as "evolving fronts" have gained tremendous popularity over the last decade. From a high-level viewpoint, active contours can be categorized based on their implementation as being either parametric active contours (PACs) or geometric active contours (GACs). PACs are generally represented in a Lagrangian formulation where the evolving curves are called "snakes," a concept first introduced by Kass

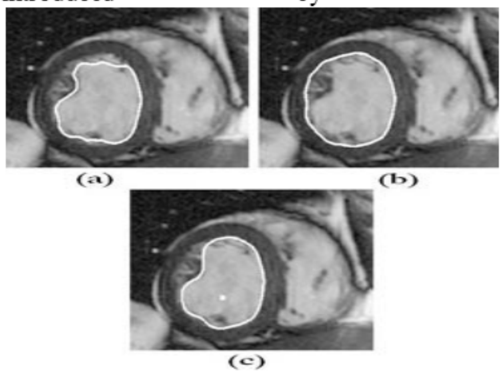

Fig. 4 Classic GAC segmentation (narrow-band, explicit time step): 21.5 seconds. (b) Multiscale GAC segmentation (narrow-band, implicit time step): 3.1 seconds. (c) Globally optimal GAC segmentation: 2.5 seconds.

A snake is defined as a curve or a deformable spline that constantly moves/evolves based on a specific energy model until it attains a shape that best fits an object (or multiple objects) of interest in the scene. This energy functional typically comprises of internal and external energy, whose combined effect drives a snake towards the boundary of an object resulting in the Among PACs, there exists a class of snakes called region-based active contours given that they are designed to attract to boundaries that distinguish homogeneous regions. Since its inception, it has been uncovered that the traditional snake model suffers from two major drawbacks that derail it from converging on the desired object of interest. The first occurs when the contour initialization is far from the true object boundary, and the second is when the object of interest has cavities that are concave in nature. To overcome the first shortcoming, multi resolution methods and pressure forces, as well as several enhanced models such as balloon/distance snake models, have been proposed. On the other hand, methods involving GVF and directional snake models have been offered to account for the second deficiency. PACs have several merits over classical segmentation techniques such as: 1. they are self accommodative in their pursuit for a global energy minimum, 2. they can be designed to be image scale dependent, and finally 3. They are not biased toward any particular object/region shape and consequently are effective for segmenting/tracking objects in spatio-temporal dimensions.

IV CONCLUSION

In this paper, we present an extensive review of recent color segmentation methodologies and highlight prominent contributions in the gray scale realm. Our classification of segmentation approaches fundamentally involves two dominant groups: 1. spatially blind methods that entirely disregard spatial information and 2. Spatially guided techniques that employ information derived from the spatial distribution of pixels. Furthermore, the aforesaid classification is not "hard," owing to the fact that there are a numerous techniques that, in some respect, integrate spatially blind processing with information that is spatially derived or vice versa, consequently fuzzifying the demarcation between them. This fuzzy nature may also be observed within subgroups of the segmentation hierarchy. Nonetheless, we have ensured that all algorithms have been placed in a group/ subgroup to which they are most relevant. Overall, our perspective of the field, based on methods discussed in this paper, have led us to make the following observations: 1. Segmentation continues to be at the forefront of many commercial and research endeavors, and the need for algorithms that perform this task efficiently is exponentially increasing with no sign of subsiding in the near future, 2. among various procedures developed within the last decade, energy-driven schemes involving active contours, Bayesian principles and graph partitioning techniques have received considerable attention relative to other mechanisms, and 3. In contrast to the 1990s, modern segmentation approaches have successfully managed to achieve higher levels of sophistication and quality, due to increased efforts to develop algorithms that combine the strengths of multiple processes to overcome existing drawbacks. While all our observations allude to advances that have been made in the area of image segmentation, we believe there are still significant contributions that have yet to be made.

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