International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Impact Factor (2012): 3.358

Review on Image Segmentation Using Mapping Method

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Abstract: ***In this paper, we are going to discuss various concepts related to image segmentation and different mapping methods. We have discussed Poincare maps for segmentation of images. To implement this method, we have to consider pair wise region comparison so that we get to know the minimum edge weight comprising between two regions and also calculate difference between both of them. We have discussed other mapping methods also which have their own importance to show grids of local surrounding points between pixels. These methods can also represent mapping of pixels in feature space. It has been shown that modes of segmentation can be very coarse or fine. They can be defined through some function that measures the boundaries which displays the difference between pair of regions. The executed region based mapping results in greedy decisions but the global property of the region is also carefully taken into consideration.***

Keywords: MAP-MRF, AD-HOC boundary, negative log, eigen vector, poincare section, minimum spanning tree, edge maximization techniques, degree of deviability, modeling interactive image segmentation.

1. Introduction

Image Segmentation is a basic procedure in digital image process which has introduced numerous applications in field of medical image processing and remote sensing image processing etc. Its motive is to take out only the required part from a complete image. The needed part is highlighted and with help of segmentation that part is extracted.
It includes two steps:-

- First step includes using proper features that can relate information and at the same time it differentiates two different information.
- Second step is about implementing segmentation in the information and obtaining the required information.

It has achieved great attention since earlier times. Vision problems can use segmented images to solve the problems. For example stereo and motion estimation requires a lot of help and support from some areas so segmentation can be used to extract out those areas. Eigenvector based methods have made great progress and attracted everyone's attention but those procedures are quiet slow. Whereas the methods we will discuss further are better and have been used on large scale in different areas.

Our method of segmentation is based upon degree of deviability among the regions of segmented area. Segmentation has to be carried out in different areas so that we get the best result after comparing all of them. In this review paper, we will discuss many ways of image segmentation like Poincare mapping, MAP-MRF method etc. In first part we will discuss about mapping and image segmentation in which we are going to discuss about the ways we can perform segmentation and how do we perform it. In this we will explain the working of segmentation process that includes boundaries and region. Then we will discuss about Poincare mapping method and other mapping methods which convert a variable into a independent variable and avoiding many other errors that occur in classical methods. Then we will discuss graph based segmentation and relation between vertices and edges.

2. Review on Image Segmentation using Mapping Method

2.1 Mapping and Image Segmentation

There are different mapping methods available for image segmentation but one of the popular mapping methods is MAP-MRF. Modeling interactive image segmentation is done by using MRF and optimization technique to solve MAP-MRF estimation problem. MAP-MRF estimation problem is based on the terms region and boundary of the image where MRF represent penalties for labelling a pixel as object or background. More particularly, the region term reflects how attributes of a pixel p (e.g. intensity value) is consistent with attributes of a label. The boundary term encodes similarity between two neighbouring pixels. There is no specific way of computing boundary or regional terms. But it consider the negative log likelihood for regional term and ad-hoc boundary term that takes similarity and spatial relation of neighbouring pixels into concern. In this mapping algorithm, the necessary thing is to formulate energy minimization problem as combinatorial graph problem. This is done by constructing a graph using sites as nodes and adding two additional nodes known as terminal nodes. The terminal nodes represent object (S) and background (T) class. The decisive part is assigning edge weights which represent region and boundary terms. The edge connecting neighbouring node is called the n-link and the edge connecting node to terminal nodes is called t-link. For optimization, whole problem is formulated as minimum cut problem where set of edges that separates the graph into two components is selected. The constraint here is that sum of these edges has to be minimum.

2.2 Poincare Mapping Method

Poincare map is the intersection of a periodic orbit in the state space of a continuous dynamical system with a certain lower dimensional subspace, called the Poincare section, for transversal to the flow of the system. In the simple form, one considers a periodic orbit with initial conditions on the Poincare section and observes the point at which this orbits first returns to the section, so it is also called as first recurrence map. The transversality of this section basically means that periodic orbits starting on the subspace flow through it and not parallel to it, it is compulsory to transform one of the dependent variables x1 into an independent one. Using the Poincare section, it is possible to make the final approach to summation in one single step, thereby avoiding the error accumulation associated with classical methods. The novelty of poincare mapping method is that, instead of applying this transformation only at the last stage, it makes one of the phase variables independent. Due to its certain different properties, it takes care of the problems associated with other methods and can also be used as a very powerful adaptive control. Mathematically, Poincare' Map are represented as a sequence of points in state-space generated by the penetration of a continuous evolution trajectory through a generalized plane in space. For periodic systems, a Poincare' Map can be obtained by sampling the system state for the forcing period. Poincare' Maps are used to characterize stability of periodic system response. The Poincare' Map of a periodic dynamical system is constructed by sampling system response at a fixed interval that equals the (minimal) period of the excitation.

2.3 Graph-Based Segmentation

Graph-based image segmentation techniques generally represent the problem in terms of a graph G = (V, E) where each node corresponds to a pixel in the image, and the edges in E connect some pairs of neighbouring pixels. A weight is associated with each edge based on some property of the pixels that it connects, such as their image intensities. Depending on the method, there may or may not be an edge connecting each pair of vertices. The earliest graph-based methods use fixed thresholds and local measures in computing segmentation. The work of graph based segmentation presents a segmentation method based on the minimum spanning tree (MST) of the graph. This method has been applied to both point clustering and image segmentation. For image segmentation the edge weights in the graph are based on the differences between pixel intensities, whereas for point clustering the weights are based on distances between points. There are different ways to measure the quality of segmentation but in general it is required that the elements in a component to be similar and elements in different components to be dissimilar. This means that edges between two vertices in the same component should have relatively low weights, and edges between vertices in different components should have higher weights. Any non-negative function of a single component can be used for t without changing the algorithmic results. For instance, it is possible to have the segmentation method prefer components of certain shapes, by defining a t which is large for components that do not fit some desired shape and small for ones that does. This would cause the segmentation algorithm to aggressively merge components that are not of the desired shape. Such a shape preference could be as weak as preferring components that are not long and thin or as strong as preferring components that match a particular shape model. The result of this would not solely be components of the desired shape, however for any two neighbouring components one of them would be of the desired shape.

2.4 EMT Technique

The threshold image by using edge maximization technique (EMT) is used when there are more than one homogenous region in image or where there is a change on illumination between the object and its background. In this case portion of the object may be merged with the background or portions of the background may as an object. For this reason any of the automatic threshold selection techniques performance becomes much better in images with large homogenous and well separated regions. This techniques segmentation depend on the research about the maximum edge threshold in the image to start segmentation that image with help the edge detection techniques operators. The edge maximization technique is based on discontinuity detection which partition an image based on abrupt changes in grey-level image by using three types of detection. The detection of isolated points in an image is straight forward by using the required mask. We can say that a point has been detected at the location on which the mask is centred. The next level of complexity involves the detection of lines in an image. Edge detection is more common for detecting discontinuities in gray level than detecting isolated points and thin lines because isolated points and thin lines so not occur frequently in most practical images. The edge is the boundary between two regions with relatively distinct gray level properties. It is assumed that in EMT technique the transition between two regions can be determined on the basis of grey level discontinuities alone. The gradient vector points in the direction of maximum rate of change of a variable at (x,y). In edge detection, an important quantity is the magnitude of the vector which will make this method effective or ineffective.

3. Conclusion

In this paper, we have discussed few image segmentation methods, the ways to perform it and why it's needed. We have brought out the different ways of performing segmentation. After comparing all these segmentation methods, we have discovered that using Poincare and graph based segmentation is easier as compared to other methods. We have sketched the different advantages of these methods and discussed segmentation concepts which can be implemented without committing errors that many other methods can perform.

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