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Image Segmentation Using Edge Detection and Poincare Mapping Method

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ABSTRACT

In this research paper, we had studied the various concepts related to image segmentation and different mapping methods. We had discussed Poincare maps for segmentation of images. To implement this method, we had considered 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 had 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 sent mapping of pixels in feature space. It has been shown that modes of segmentation can be very coarse or fine.

Key words: Active contour models (ACM), EMT, ISFA, ordinary differential equations (ODE), ISAF

INTRODUCTION

Segmentation for objects of interest from the image data is an important task in computer vision. Within this area, active contour models (ACMs) [1] or snakes have become popular by exhibiting their powerful abilities in object detection and shape representation within the past two decades. Active contours are usually defined by the curve flows mainly derived from minimizing some variation problems or energy functional [2]. Generally, there are two types of ACMs, i.e., parametric active contours and geometric active contours GACs [3]. The former type usually establishes energy functional composed of internal and external energy terms. It is not intrinsic and has difficulty in determining and handling the topological changes of evolving contours. The latter one constructs an intrinsic Riemannian metric-based functional. Then, the active contours are treated as the zero crossings of level-set functions [4]. It can tackle topological changes elegantly at the cost of more computational costs. To our understanding, there are mainly three difficulties with the above active contours [4]. First, the evolution direction of the active contour should be predefined. Second, they are usually sensitive to initialization, that is, they will slowly evolve and even wrongly converge as the initial contour is far away from or cross the desired boundaries [5]. Third, the active contour usually sticks into some local minima of the energy functional and, thus, cannot progress further into the deep concavities of the boundaries [6]. Within the many efforts working on the above difficulties, two types of methods are important. One type is region-based methods, where energy optimization is not driven by boundary information but by region information of the image [7]. In particular, optimization is done using the statistical information both inside and outside the active contour [4]. Another type of method aims to pull the active contour to the desired boundaries by some new external force fields [8]. Moreover, the tool of the vector field was adopted herein and proven to be effective. These vector fields are to take the role of the external force fields for the evolving active contour [9]. For normal methods, a smoothed vector field is generated by diffusing the gradient of the edge map for an observed image to the whole image domain to enlarge the capture range of the contour [10]. This way, the active contour will move across the local minima, where it is usually stuck [2]. The intrinsic model is an integration of GGVF and GAC has more freedom in initialization and can deal with topological changes [11].

TECHNIQUE AND METHODS

Implementation of Poincare mapping method for Boundary Extraction

The objective of the proposed system is:

1. Object segmentation using Poincare map method in a define vector field in dynamical systems.
2. Generating the ISFA filed for the image which contains two swirling and attracting components for an image.

3. Set the initial sates on the basin of attraction (the limit cycles) and calculate the convergence of the states with the limit cycles of an image and simultaneously also calculate the orbits.
4. The objects' boundaries are linked by integral equations with the corresponding converged states and periods.

In this system object segmentation is achieved by the Poincare map method within the dynamical systems. Thus, this is achieved by the following modules:

- Framework of Dynamical Systems
- Poincare Map and Newton-Raphson algorithm
- Multiple objects Segmentation

Framework of Dynamical System

After generating the ISAF field for the given image where its eddies or swirl correspond to the object's boundaries. This state the limit cycles in the dynamical systems, where dynamical system is defined as array of Ordinary DE (ordinary differential equations).The eddies here can be considered as limit cycles of a vector field that belong to dynamical system. These limit cycles are located, including their periods and candidate points on the limit cycles.

Poincare Map and Newton-Raphson Algorithm

Poincare (definition): it is the intersection of periodic orbit in the state space of continuous dynamical system with a certain lower dimensional subspace called as Poincare section [12]. This Poincare section is used to set the limit cycles for which the Poincare section lies. The Poincare section is described as follows: $\sum = X \vdots < X - X_0, h^* >= 0$
The Newton-Raphson method is used for zero computation of periods in Poincare section. As poor the value of period is, Newton-Raphson sequence causes positive Poincare on χ 0 far away from χ 0 even if it is on the limit cycle.

Multiple Object Segmentation

In this phase after the ISAF field has been generated for an image N distinct initial states randomly in image domain can be placed which corresponds to the number of objects in an image. Then, these N states will move within the flow field and finally will move to the object' boundaries. In this for each initial states Poincare section are defined and with the help of Newton-Raphson algorithm the fixed point for corresponding Poincare map is calculated (i.e. determines the N converged states on the boundaries) as well as simultaneously calculate the periods implicitly. The representation for the object's boundaries with N converged states is: $B = X^l(\tau) \vdots \tau \in [0, \tau^l]_{l=1} N$
Where $X^{(\tau)} = X_0 * (1) + \int \gamma\big(Xl(s)\big)ds,\ l = 1, \dots .N$
Here B denotes the object boundaries with N converged states, X (τ) denote the periods for *l*=1….N and N are the number of initial states on the boundary.We has used the following algorithm for generating Poincare section*:*

a) Initialize all the parameter for beginning of steady state.
b) Calculate the length of t and store it.
c) Calculate the Poincare section for each pixel (x, y) as
Poincare _x= [x (round (m*per), res: m, 1]
Poincare _y= [x (round (m*per), res: m, 2]
d) Plot the Poincare section functions.

RESULTS AND DISCUSSION

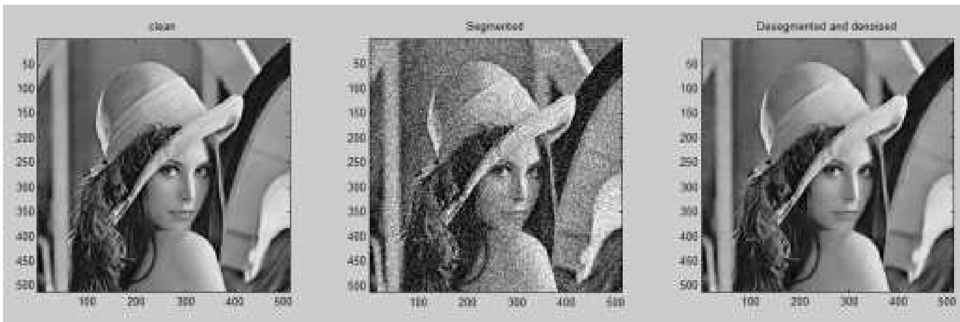

Fig.1 Original image and segmented, noise free image

In this paper, we have implemented and analyzed the problems and methodology of user applying Poincare method only at the last stage for different types of images. This study had given us the overview of the previous work done in this field to implement the system efficiently. We have studied the previous approaches and techniques that have been applied till date in mapping methods for image segmentation to find out the good and bad points of these methods. We have done implementation of the Poincare method as per the algorithm given above for improvement of the system and performed comparative analysis of the basic implementations already done to evaluated techniques available.The algorithm implementation had been done in MATLAB by using image processing toolbox for 2D/3D images. The Poincare algorithm had been implemented and the results are as shown in the Fig.s given below. In Fig. 1, method for image segmentation based on pairwise region comparison had been implemented. It had been shown that the notions of a segmentation being too coarse or too fine can be defined in terms of a function which measures the evidence for a boundary between a pair of regions.

We have represented our image segmentation with different kinds of graphs so that we can represent the image as a grid of local neighbourhood points between image pixels or it can also represent mapping of image pixels to in a feature space as shown in Fig. 2.

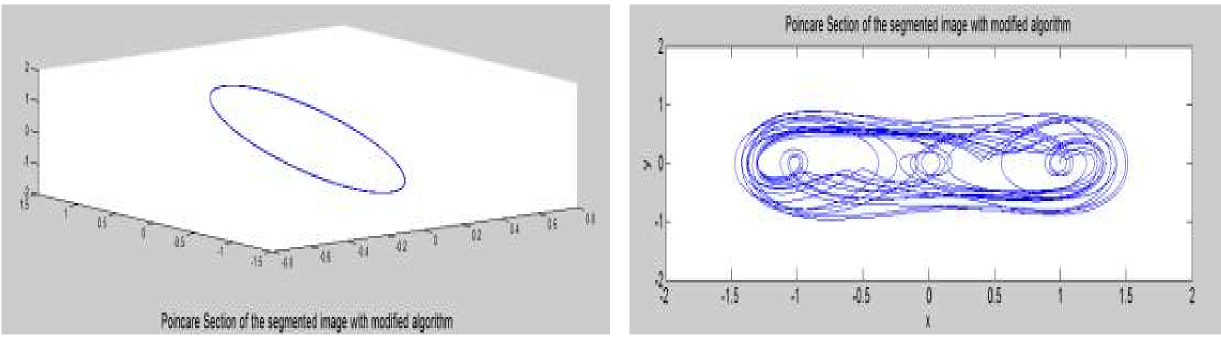

Fig. 2 Poincare map implemented for image as a grid of local neighborhood points

CONCLUSION

In this paper, we classify and discuss main image segmentation algorithms. Image segmentation has a promising future as the universal segmentation algorithm and has become the focus of contemporary research. In spite of several decades of research up to now to the knowledge of authors, there is no universally accepted method for image segmentation, as the result of image segmentation is affected by lots of factors, such as: homogeneity of images, spatial characteristics of the image continuity, texture, image content. Thus there is no single method which can be considered good for all type of images or all methods equally good for a particular type of image. Due to all above factors, image segmentation remains a challenging problem in image processing and computer vision and is still a pending problem in the world. The object segmentation is achieved in a novel manner by the Poincaré map method in the field of dynamical systems.

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