

## Research on the application of super pixel in image processing

Lei Xu<sup>1</sup>, Yueping Peng<sup>2</sup>, Kening He<sup>1</sup>

<sup>1</sup>Graduate Management Unit, Engineering University of PAP, Xi'an, Shanxi, 710086, China

<sup>2</sup>Department of Information Engineering, Engineering University of PAP, Xi'an, Shanxi, 710086, China

### Abstract

Super pixel is a kind of image processing technology which can reduce the complexity of image processing in image acquisition of redundant information technology, and it has been widely used in the field of computer vision. This paper firstly introduces the development status of super pixel technology, and then summarized the application of super pixels in different areas with documents. Lastly put forward the outlook of super pixel technology according to the analysis of its advantages and disadvantages.

### Keywords

Super pixel; image processing; image segmentation; target tracking.

### 1. Introduction

Recently the development of computer technology have pushed the progress of human society to intelligence, it has a wide range of application in military, transportation, medical and other fields. Super pixels is a kind of image block which consist of adjacent pixels with similar color, texture and other features. It is to use a number of pixels which are consistent and can keep the local image characteristics as a structured whole, its purpose is to improve the accuracy of target operation, reduce the complexity of calculation. Super pixel is different from the pixel because it is the concepts of a set, including some image features that a single pixel doesn't have [1], it can gather the pixel into spatial information of objects which are easy to identify and calculate sub regions. The super pixel is mainly used to conduct the pretreatment before image processing, it can get the redundant information of the image by grouping, thereby reducing the risk of merging irrelevant pixels, so it is the key technology in the field of computer vision, and it is widely used in object detection, object segmentation and object tracking. The wide application of super pixel algorithm makes the image processing technology become more intelligent and perfect, the efficiency is also increasing [2].

### 2. Image segmentation based on super pixel

Image segmentation is to divide the image into disjoint regions with special semantics through the similarity criterion, its purpose is to extract interesting information from complex images. The traditional segmentation method is to deal with pixels as the basic unit, it can apply to the images with relatively simple content. However the calculation efficiency of the large size image is low, it has some limitations, and the characteristics of super pixels can extract the middle image feature makes it is usually used to do the pretreatment of image segmentation algorithm [3]. Super pixels has great development prospects because its advantage is that the segmentation doesn't affect the boundary of target region. Unlike the traditional segmentation method that divide the target image into blocks with fixed shape, it can obtain adaptive target region without damage. The segmentation evaluation of super pixel is a measure of whether the algorithm of super pixel is optimized, the standard includes calculation efficiency, compactness, controllability and other standards: the efficiency is measured by calculating time and complexity, also the concurrency can produce an impact; compactness is mainly refers to the average area and area variance of super pixel, it can used to reflect whether the area is uniform, thereby reducing the area difference; algorithm controllability is that the algorithm can accurately control the generated quantity and compactness of super pixels [4]. At present, the super

pixel segmentation algorithm mainly consists of two kinds: algorithm based on graph theory and algorithm based on gradient, one is transform the segmentation problem into the problem of minimizing energy function which is based on the segmentation criterion to divide the image, the other is to modify the clustering results constantly through a gradient iteration so as to form a super pixel [5]. According to the advantages and disadvantages of the two algorithms, this paper proposes a segmentation algorithm of super pixel image based on visual saliency, the principle is: firstly, using the SLIC method with little memory and the property of preserving image boundaries to generate super pixels and make the saliency map, then calculate the mean of each significant super pixels to determine the threshold, and automatically generate the foreground and background of super pixel subset, then extract feature vector for SVM training. If the sample which has same proportion of foreground and background subset is used on training, it will lead to decrease the performance of classifier, so the proportion of their size must be calculated first. That is:

$$\text{rat} = \frac{F}{B} \quad (1)$$

Make  $\alpha F$  and  $\alpha B$  to express the super pixel subset of foreground and background respectively,  $\beta$  for adjustment coefficient and through the following function to select the training sample:

$$\begin{cases} \alpha_F = \alpha \times \frac{1}{\text{rat}} + \beta, \alpha_B = \alpha, \text{当} \text{rat} < 0.75 \\ \alpha_F = \alpha_B = \alpha, \text{当} 0.75 \leq \text{rat} \leq 1.25 \\ \alpha_F = \alpha, \alpha_B = \alpha \times \text{rat} + \beta, \text{当} \text{rat} > 1.25 \end{cases} \quad (2)$$

Finally, classify the pixels by the SVM classifier[6].

Super pixel algorithm can produce compact super pixels with same size and control the number to make the boundary is closer to the object boundary. The use of super pixels instead of pixels can effectively reduce the data quantity of image processing, improve segmentation speed, and avoid the influence of size problem on segmentation efficiency. The drawback is that it is difficult to achieve a better segmentation result when the number of pixels is less, because the user is hoping to get the less number of super pixels for the super pixel has redundant information. Currently super pixel algorithm has some constraints on the segmentation quality, the practicability and the number of pixels, and it is difficult to achieve good results for some special cases of object segmentation. In addition it only uses the local feature distribution of the image, so it is not comprehensive enough to consider the distribution of global significant information and the boundary preservation.

### 3. Target tracking based on super pixel

It can be used to track suspicious targets in the military field; monitor road traffic in real time and track of pedestrians for the transportation; provide more reliable medical data in health care and etc. Object tracking is a kind of means which can track and position the moving targets by using a certain algorithm after converting the video into a frame image with temporal and spatial correlation of information, such as license plate recognition, human-computer interaction. The algorithm can be divided into three categories: deterministic algorithm, probabilistic algorithm and classification algorithm, the difficulty is how to overcome the influence of target deformation, dynamic change of the scene and occlusion problem in the tracking process for accurate, robust and real-time tracking[7]. The reference of super pixel can optimize the tracking algorithm to a certain extent. The SPL1 algorithm based on superpixels can be used to introduce the application of super pixel in target tracking. It consists of two parts of training and tracking, the diagram is as follows:

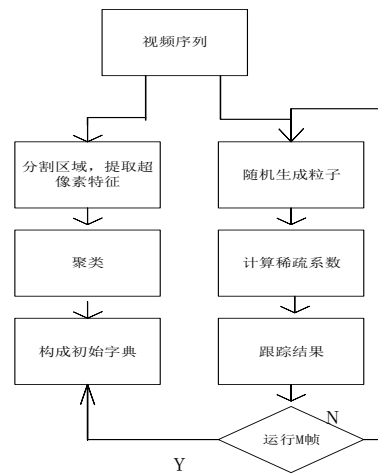


Fig.1 the flowchart of that algorithm

(1)When training the first  $m$  frames in the video sequence, super pixel feature can be extracted by segmenting the target and its surrounding area, and then use the normalized color histogram to express it.

(2)Using the mean shift clustering method to cluster the pixels in the training phase, and the  $N$  cluster are given  $n$  weight:the large weight represent the target, the small is the background,so the weight of the  $K$  clustering is:

$$W_k = \frac{S^+(k) - S^-(k)}{S^+(i) + S^-(i)} \quad (3)$$

The  $S^+(k)$  means the acreage of overlap between the target area and clustering region,  $S^-(k)$  is the acreage of overlap between the target area and background area, the value of  $W_k$  is proportional to the possibility that the cluster represent the target. Therefore the expression can be used to judge whether the super pixel belongs to the target.

(3)To construct the initial dictionary which includes the target and background information by clustering the center vectors.

(4)Taking the position of the previous frame as the center, and sampling  $N$  particles to represent the candidate target state randomly.Then calculating the sparse coefficient of particles,the dictionary is updated every  $M$  frames, and judge whether the target is occluded by comparing the reconstruction error with the predefined value,The expression of reconstruction error is:

$$er = \|X - AZ\|^2 \quad (4)$$

In that expression,  $A$  is the target template,  $X$  is the result of the target tracking in the frame, and  $Z$  is the sparse coefficient in  $A$ .

Super pixel can separate the target and background, reduce the risk of missing the goal by constantly updating model, which makes the tracking effect will not be weakened due to the target occlusion or background interference, or even failure.However the calculation is large and the errors in the calculation of background confidential value will indirectly lead to tracking errors.

#### 4. Model reconstruction based on super pixel

Computer graphic design usually carry out the visual reconstruction to improve the design of three-dimensional with help of three-dimensional model, but three-dimensional model is easy to have the poor reconstruction effect with the interference of noise. The proposed model is carrying out the visual by segmenting the output image after feature acquisition and noise reduction of three-D model to achieve optimization and improvement of algorithm[8]. The constructed 3D model needs to meet three basic requirements of integrity, efficiency and integration: integrity refers to the model system needs to have complete data including parts, assembly structure and etc; high efficiency require to have the clear and reasonable model structure and have a certain efficiency in the implementation;

integration is needed to meet the requirements of importing the data of the system, graphic design and supplementary data into the same model. Because of the influence of noise, the wavelet denoising is needed, its expression is :

$$W(t+1) = 4.0W(t)(1 - W(t)) \quad (5)$$

$$W(t) = W_{\min} + (W_{\max} - W_{\min})W(t) \quad (6)$$

The  $[W_{\min}, W_{\max}]$  is the inter class texture enhancement coefficient of 3D model visual image. The wavelet function is used to calculate the output the space vector of image noise after denoising to realize the denoising and filtering of image[9], then calculate the motion amplitude of the reconstructed region as the normalized texture pixels can improve the detection capability of the 3D model. Finally, the intensity superposition of two images is used to reduce the regional differences of edge detection value and mesh the grid distribution of reconstructed texture information, in order to achieve the improvement of 3D reconstruction and optimization of graphic design.

The visual reconstruction of super pixel can reduce the error rate of image reconstruction and optimize the visual effects of reconsitution, its extracted resolution is better than the traditional method as it can show more accurate visual information and improve the performance of visual reconstruction that has a certain effect on the beautification of visual information. However there still exist some shortcomings, such as complex calculation and image distortion.

## 5. Conclusion

Super pixels can also be applied to other aspects of image processing, such as image scene classification, region merging, image analysis and so on. It has become an important part in the field of computer vision, its wide application and good effect make it still has ascending space in the improvement of speed and accuracy.

Super pixel algorithm is an important research direction in image analyzing and processing, it can calculate based on the classical algorithm quickly and effectively, and reduce the computational complexity. This algorithm is more conducive to the extraction of local image feature and can effectively reduce size and complexity of object processing[10]. It has a good edge fitting which can effect the quality of segmentation and consolidated result to some extent. Reducing the number of the super pixel on the basis of keeping the edge characteristics of super pixels is beneficial to the extraction of local features, also can achieve the effect of algorithm optimization and time contraction. In addition to the advantages in image pretreatment, it can also be used for post-processing, but it is undeniable that it still has some limitations that is unable to achieve the best in terms of quality, efficiency and so on currently. It is necessary to try determine the best effect through repeated attempts in actual application, that will increase the burden of interaction, so that resulting in a lack of adaptive and practical. Moreover, the extraction and expression of super pixel in processing are not diversified which need further comprehensive expression and description. In future research, we may consider carrying out the research of conspicuousness by adding the feature information such as texture and color, can also improve the accuracy of detection with combination of top-down prior information.

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### Authors

Xu Lei:female,corresponding author, born in November 1992, Han nationality, master,combat environment research direction, 734052869@qq.com.