Theoretical Research on Digital Image Processing based on MATLAB

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***Abstract* - With the rapid development of machine learning and image processing, the combination of the two methods is well appreciated recently. The application of the theory of fractional calculus at the bottom of the image processing is scholars concern in recent years. In this paper, we introduce research on the basic application of image processing with the help of MATLAB implementation. Due to the actual problem of application type each are not identical, so the image feature extraction has been no precise definition and many computer image analysis and algorithm are characterized in the point of tangency. The success of the algorithm and its use and define the characteristics of the interest rate. In the future, we plan to conduct more related research to modify the current review.**

Keywords - MATLAB Programming; Digital Imaging; Segmentation and Representation

I. INTRODUCTION

After decades of effort, the power of sparse representation has been gradually revealed in visual computation areas. Image processing technique is becoming more and more theoretically researched and analyzed. Image feature extraction is a cross discipline, it is included in the computer vision technology and are also included in the image processing applications. Through a computer analysis and processing, the mission is to extract the image invariant features and solve practical problems. The image feature extraction is often involved in mathematics, physics, control theory, computer science and other aspects of knowledge. Nowadays, image feature extraction techniques have been applied to all areas of our lives such as the reconstruction of old buildings and protection, remote sensing image analysis, urban planning and medical diagnosis, etc. The image feature extraction technology has not only created a new scientific and technological achievement and greatly improves the accuracy of the digital and accuracy. Due to the actual problem of application type each are not identical, so the image feature extraction has been no precise definition and many computer image analysis and algorithm are characterized in the point of tangency. The success of the algorithm and its use and define the characteristics of the interest rate. The definition of image processing and corresponding feature extraction is described as the follows: Image processing is one of the most primary operation feature extraction, so the digital image of computation is conducted first feature extraction, and then through the operation to check for each pixel of the image and finally determine the characteristics of the pixel [1-3].

Check if the algorithm is the image of some of the characteristics of the area, then the image feature extraction is part of the algorithm. As a premise of feature extraction arithmetic, the input image generally smooth in scale space and finally calculated uses the derivative principle characteristic of the image. Although this approach is simple: the classifier does not have to deal with invariance which serves as a key drawback of this approach is computational complexity. On typical images these classifiers can be evaluated several tens of thousands of times. One may also want to search over aspect ratios, viewpoints, etc., compounding the problem. Therefore efficient classifiers are crucial for effective detectors [4].

In recent years, many scholars at home and abroad has been conducting the study found in the field of signal analysis and processing of fractional calculus has wide application prospects such as the signal singularity detection and extraction has a special role. The application of the theory of fractional calculus at the bottom of the image processing is scholars concern in recent years and so far, it has made the preliminary research results including image enhancement, image de-noising, image edge detection, image segmentation, image singularity detection and more related applications [5-6]. The feature extraction with MATLAB leads the research, as well as, which is shown in the figure 1.

Therefore, to review and undertake theoretical analysis on the technique we will introduce research on the basic application of image processing with the help of MATLAB implementation which will be discussed in detail in the following sections.

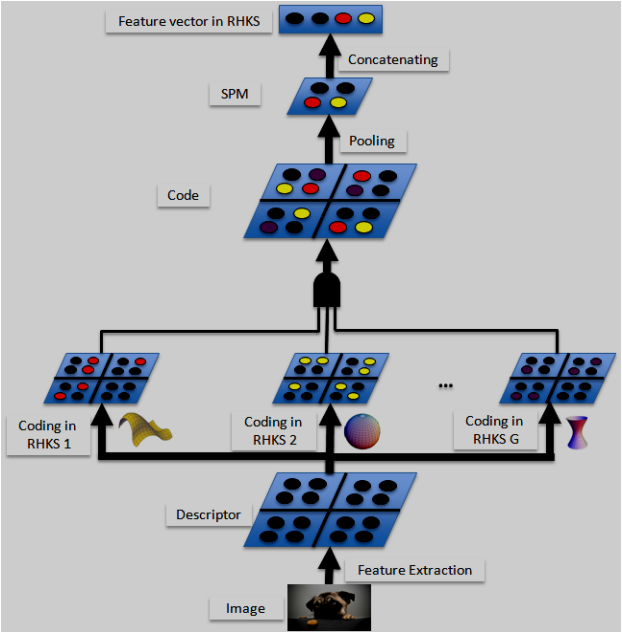

Figure 1.The General Concepts of Image Processing and Feature Extraction

II. PRINCIPLES AND APPLICATIONS OF IMAGE PROCESSING

The Feature Extraction for Image Processing. Image features extraction with high extraction efficiency so it has been widely used. The current image feature extraction technology has been more and more attention from scholars but there are still shortage and problems to be solved: the lack of unified evaluation criteria; image extraction system of relatively large amount of calculation, etc. Compared with the classic methods to improve and update method is proposed in this study the author effort direction. Texture features and color features are similar and it is also a kind of holistic characteristics. In recent years, the various theories or methods of texture analysis method in the application of texture feature extraction has basically taken shape, therefore we put the texture feature extraction method is classified into five categories, namely structure method, the signal processing method, the geometric method, model method and statistical method [7-9]. In the following formula 1 we define the probability theory based approach for extraction.

$$\int F(x)d(x)=1 \tag{1}$$

Traditional image methods are mainly concentrated in the airspace or local analysis of frequency domain, so the suppress image noise at the same time and the loss of image detail information which make the image blur after processing. The formula 2~3 show the procedure.

$$\varphi_k=\int(r-\phi_1)^k F(r)dr, \quad k=0,1,2,... \tag{2}$$

$$\iint F(x,y)dxdy=1 \tag{3}$$

Fractional order partial differential equation by traditional integer order partial differential equation is the development evolution which is the traditional integer order partial differential equations of the partial derivative of time or space item with fractional order partial derivative instead. The expression 4 illustrates the definition. The fractional order calculus theory and the combination of partial differential equation which puts forward the image processing technique based on fractional order partial differential equation model and this method can solve the traditional low-order time integer order partial differential equations model is easy to produce staircase effect, and high order integer order partial differential equations.

$$\frac{\partial^\alpha f(x,y,t)}{\partial^\alpha t}=\frac{\partial^\beta f(x,y)}{\partial^\beta x}+\frac{\partial^\beta f(x,y)}{\partial^\beta y} \tag{4}$$

The FK combines the benefits of generative and discriminative approaches to pattern classification by deriving a kernel from a generative model of the data. In a nutshell, it consists in characterizing a sample by its deviation from the generative model. The deviation is measured by computing the gradient of the sample log-likelihood with respect to the model parameters.

The Image Segmentation Applications. In view of the theoretical significance and practical value of graph cuts, the image segmentation methods based on graph cuts is becoming more and more acceptable. First image segmentation problem as energy function minimization problem, when the energy function is the most hours realize the optimal image segmentation. Then, for a given energy function defines a figure, it is necessary to figure the cost of the cut set is exactly equal to the given energy function. Finally, through the figure of the minimum cut we could achieve a given to minimize the energy function which has realized the optimal image segmentation. We motivate our discussion using the histogram intersection or the min kernel. Often similarity between images is obtained by comparing their distribution over low level features like edge orientations, pixel color values, codebook entries, etc. These distributions could be represented as histograms and a similarity measure like the histogram intersection can be used. Clustering image segmentation algorithm combined with sparse coding can effectively the local information of fused image which is easy to use the internal correlation between pixels, but for splitting the problem of segmentation and pixels are difficult to categorize. To this end, the dictionary of the learning process, to the introduction of the atom clustering algorithm which helps to reduce the number of dictionary atoms in that category, prevent segmentation; Considering the pixel and its neighborhood pixels has the characteristics of category attributes consistency, introduced the space category attribute constraint information, and an alternating optimization algorithm is presented. There is no dictionary learning involved. They apply it to large image feature vectors, such as Fisher encoding, and the cost of nonlinear SVM prediction is reduced by this approximation while maintaining the classification accuracy above an

acceptable threshold. A joint study dictionary, sparse coefficient, clustering center and the membership degree, the coefficient of sparse coding with atomic membership degree of cluster center, the combination of tectonic pixels of degrees to determine pixel belongs to category. In the following formulas, we illustrate this occasion. The figure 2 shows the analyzing matrix.

$$\min_{U,V} \sum_{i=1}^{n} \left\| x_i - V u_i \right\|_F^2, \qquad s.t. card\left(u_i\right) = 1 \tag{5}$$

$$\arg\min_{D,A} \left\{ \sum_{i=1}^{n} \left\| x_i - D \cdot \alpha_i \right\|_F^2 + \lambda \left\| \alpha_i \right\|_1 \right\} \tag{6}$$

Figure 2.The Analysing Matrix for the Segmentation Algorithm

MRF maximum a posteriori estimation during the image segmentation to get the image segmentation results and the MRF maximum a posteriori estimation is equivalent to the discrete energy minimization. Discrete energy minimization method includes randomness and uncertainty method, among them, the figure cut is very important to a deterministic discrete energy minimization method, is widely used in image segmentation field. This paper mainly expounds the basic principle of image segmentation method based on graph cut and the main features from the perspective of algebraic transformation method to determine the weighing values of edge is given and demonstrates the figure cost minimum cut set equal to the minimum value of a given energy function.

The Image Representation Algorithm. We are especially interested in the large-scale setting where one has to deal with a large number of images and classes. Large-scale image classification is a problem which has received an increasing amount of attention over the past few years as larger labeled images datasets have become available to the research community. A feature of the remote sensing image is different from natural images in remote sensing image has the characteristics of multichannel imaging. In information extraction of remote sensing image, and make full use of remote sensing image must be taken into account comprehensively in the characteristics of each band in order to improve the accuracy of information extraction. Ideal results of remote sensing image segmentation is the resulting object segmentation has good internal homogeneity, good heterogeneity between adjacent objects at the same time, and within the object segmentation after homogeneity and heterogeneity between objects can be reflected in each band. Based on this idea, this article puts forward the model of calculation method considering the lack of a single band, is proposed based on improved multichannel model calculation method to choose the optimal measure of image segmentation, in order to get the best segmentation result.

In recent years, many scholars will be applied to image enhancement in the fractional order differential theory and good results have been achieved. Fractional order differentiation can improve signal in the high frequency component of nonlinear to retain the general signals at the same time, so the theory is applied to image enhancement and image edge can be more outstanding while retaining the texture information of the image smooth area. Fractional integral operator in weaken the high frequency part of signal at the same time, the nonlinear of the part of the highest frequency in the reserve; Fractional integral operator in strengthening the low frequency part of signal at the same time and the low frequency part of them also has carried on the certain reservations. In this way, the fractional integral operator in removing the noise at the same time to a certain extent which retained the image edge and texture details so that after processing image won't produce severe fuzzy phenomenon. The following formula describes this step.

$$\begin{cases} d^n\left(w\right) = \left(iw\right)^n = \alpha^n\left(w\right) e^{i\theta n(w)} \\ \alpha^n\left(w\right) = \left(w\right)^n = d^n\left(w\right) e^{i\theta n(w)} \end{cases} \tag{7}$$

Although linear SVMs are popular for efficiency reasons, several non-linear kernels are used in computer vision as they provide better accuracy. Some of the most popular ones are based on comparing histograms of low level features like colour and texture computed over the image and using a kernel derived from histogram intersection or chi squared distance to train a SVM classifier. In order to evaluate the classification function, a test histogram is compared to a histogram for each of the support vectors. The following expression is the final objective function.

$$INV = \sum_{m=0}^{L-1} \sum_{n=0}^{L-1} \left| m-n \right|^k P\left(m,n\right) \tag{8}$$

The Image Classification Applications. Spatial relations show that the image segmentation of there is a certain spatial location relationship between multiple targets and directional relationship, such as images of adjacency relations with connection, image of tolerance and inclusion relation, etc. There are two kinds of commonly used image space feature extraction methods: according to the image of the object or colour, and other features after segmentation of the image are extracted; and the sub-block image segmentation into rules, characteristics of each sub-block image are extracted. Before because of multiband image segmentation can set different band weight, heavy said segmentation process should consider more information of the band. Therefore, in the measure of homogeneity and heterogeneity of the

segmentation result, should be adopted in the process of segmentation is larger also gives greater weight, weight of band in the segmentation process and segmentation evaluation standard consistency, and quality of the segmentation results of assessment to establish connection with the process of segmentation. The idea of this method is: use the inside of the object expressed by the standard deviation of internal homogeneity, using spatial correlation to represent the heterogeneity between objects which makes the internal homogeneity and heterogeneity between object to achieve the best comprehensive effect. The model automatically calculated the optimal scale which is convenient and quick, high credibility and to avoid the subjectivity of human visual. The formula 9 shows general expression.

$$K_{MIN}\left(X,Z\right)=\sum_{i=1}^{n}\min\left(x_i,z_i\right) \tag{9}$$

It is possible to compute approximate versions of the classifier even faster. Traditional function approximation quickly breaks down as the number of dimension increase. In the next section, we will conduct related experiment to illustrate the result.

III. EXPERIMENT AND SIMULATION RESULT

We now report results on the large-scale ILSVRC 2010 and ImageNet10K datasets. The FV computation settings are almost identical to those of the small-scale experiments. The only two differences are the following ones. We first study the impact of the compression parameters on the accuracy. We can vary the average number of bits per dimension b and the group size G. We show results on 4K-dim and 64K-dim FV features in figure 3.

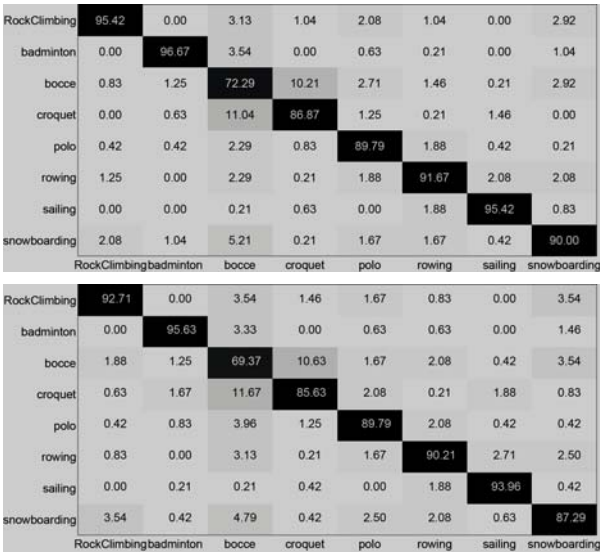

Figure 3. The Experimental Result Set One

To show the real-world result for optical images, we conduct experiment two to show the result. The numerical analysis result is shown in the figure 4.

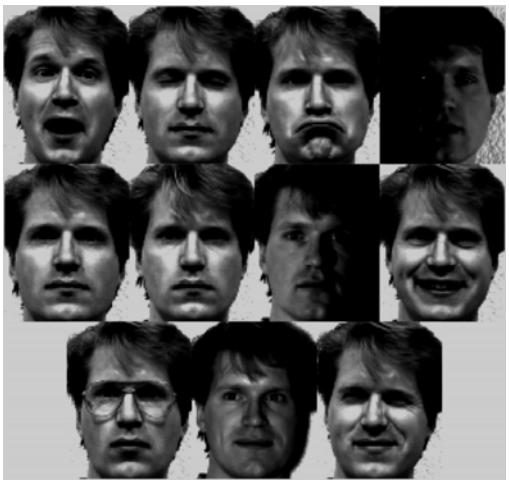

Figure 4. The Experimental Result Set Two

IV. CONCLUSION

Access to image information is very important, but the objective is not only to have the image, and what is more important to image information processing, in a large number of complex images to find the information we need. So the image information processing in a sense, is more important than get images, especially in today's era of rapid development of science and technology, higher requirements are put forward for image information processing, so that more rapid, accurate, and reliable to obtain useful information. Digital image processing is a computer using a certain algorithm of image processing technology. Digital image processing technology has been in various fields have more extensive application. Image processing large amount of information has big requirement of processing speed. MATLAB powerful computing and graphics display function, make image processing becomes more simple and intuitive.

Image feature extraction is a cross discipline, it is included in the computer vision technology and are also included in the image processing applications. In this paper, we conduct research on digital image processing based on MATLAB. In recent years, many scholars will be applied to image enhancement in the fractional order differential theory and good results have been achieved. As a premise of feature extraction arithmetic, the input image generally smooth in scale space and finally calculated uses the derivative principle characteristic of the image. The final result shows the meaning of the research.

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