

KEY OF PACKAGED GRAIN QUANTITY RECOGNITION—RESEARCH ON PROCESSING AND DESCRIBING OF “FISH SCALE BODY”

Ying Lin^{1,2}, Xinglin Fang¹, Yueheng Sun^{2,*}, Yanhong Sun¹

¹ College of management, Chongqing Jiao Tong University, Chongqing, P.R China, 400074;

² School of Computer Science and Technology, Tianjin University, Tianjin, China, 300072;

* Corresponding author, Address: School of Computer Science and Technology, Tianjin University, Tianjin, China, 300072, Tel: +86-22-27401016, Email: yhs@tju.edu.cn

Abstract: The key to identifying the packaged grain is the shape of package, and the key to identifying shape is processing and describing the boundary of package. Based on a lot of analysis and experiment, this article select the canny operator and chain code to process and describe the boundary of package. Aiming at the boundary is not absolute connectivity, the closure operation of Mathematical Morphology is introduced to do pretreatment on binary image of packaged grain. Finally the boundary is absolute connectivity. Experiments show that the proposed method enhances the anti-jamming and robustness of edge detection.

Keywords: edge detection; Mathematical Morphology; Chain code

1. INTRODUCTION

The technique core of grain reserves automatically supervision and audit system which based on video is to identify the grain deport scene video, accurately gets the sum of grain quantity to replace the mode that pass by manual's supervision, and eradicate completely empty grain deport and make a false report to get more interest phenomenon. Thus, administration section is satisfied with requirement of grain reserves automatically supervision and audit (Lin et al., 2007).

The grain packages in the grain deport three-dimensional pile up by pursuing layer toward the vertex layer from the first floor, forming a big cube type structure. In the image caught by camera device, the big cube contains three sides, is vertex face and two on the sides respectively. Because of illumination and the mode of piling up, in the video image, the gray level in different place of the grain package surface will have very big difference, the center region of grain package would be brighter, but the peripheral region is relative ash dark, so on the vision, the grain package edge presents an approximate ellipse and all grain packages ellipse edge connectivity together seems to be fish scale, so we call "fish scale body" to the ellipse that the grain packages forming. Each grain package can see three different sides in the video image, so the grain package will form three classes different ellipse "fish scale body". If we accurately identify the quantity of the "fish scale body" on the three sides of the big cube, so the quantity of grain package can identify. Because the weight of each packaged grain is fixed and have already knew, we will obtain the weight of the whole cube grain pile, therefore, the packaged grain quantity recognition is to the recognition of the ellipse "fish scale body" quantity. So the key to identifying the quantity of packaged grain of grain deport is to find a fast, accurate and valid method to extract and describe the shape of ellipse "fish scale body" to assured accurately identify each ellipse "fish scale body".

The image processing of ellipse "fish scale body" mainly includes ellipse "fish scale body" edge location and description. This paper final select Canny operator to detect the edge and edge direction chain code to describe the edge of grain package based on analyzing, researching and doing experiment on the existing edge detection operator. Aiming at the detected ellipse "fish scale body" edge has a little incomplete occlusive character, this paper adopts the close operate of mathematical morphology to repair and link the edge nick. Finally the experiments show that canny operator and edge direction chain code detect and describe ellipse "fish scale body" have a higher robustness, can acquire better effect..

2. "FISH SCALE BODY" EDGE DETECTION RESEARCH

Edge means that the difference of gray value of adjacent pixel in the image contrasts sharply, it is extensively exist between target and other target, target and background (Yao et al., 2006). The image edge is one of the most important features of image, which is an important basis of image analyses, such as image segmentation, texture feature and shape feature. Specific to the packaged grain image, the edge described the shape information of ellipse "fish scale body", and the shape information is the

basis to exactly identify and analyze the ellipse "fish scale body", so the chief operation to the packaged grain image is the edge detection of ellipse "fish scale body".

So far people have put forward various different edge detection algorithms, such as Roberts operator, Sobel operator, Prewitt operator, Log operator, Canny operator and so on (Gong et al., 2006). In the digital image, edge and noise pixel point both belong to the gray value abrupt change point, so in the edge detection, edge detection capability is in contradiction with noise suppression capability. Some algorithms have a better capability of edge detection, others have a better antinoise ability. Each operator has its own advantage.

2.1 Operators

The Roberts operator is also called the operator of gradients cross, it makes use of a local difference operator to look for edge, and provides a simple approximate method for calculating the gradient amplitude:

$$G(i, j) = |f(i, j) - f(i + 1, j + 1)| + |f(i + 1, j) - f(i, j + 1)| \quad (1)$$

The Roberts operator has powerful ability in edge detection, and would be highly effective to steep low noise image. But it easily to lose partial edges, is better to have a steep low noise image substitution.

The Sobel operator adopts neighborhood means, so it can avoid calculating gradient between the pixels inside points. The Sobel operator puts a focal point in the pixel which is close to template center, and the order of operate is weighted average, then differential, lastly calculated gradient.

The Sobel operator is preferable in processing the image which its gray value gradual changed and has low noise, but it isn't isotropic, so edge detection is not complete connectivity, and the edge detected easily appears many pixel widths.

The fundamental principle of the Prewitt operator is the same with the Sobel operator, but the two convolution templates is not the same with the Sobel operator.

The first derivative will get extremum at the position where the pixel gray value tremendous change, in contrast, the first derivative value is zero at others position. The extremum point of the first derivative definitely lead to the second derivative arise passing zero positions, which apropos correspond to edge of original image. So we can make use of passing zero positions of the second derivative to detect the image edge.

In the two-dimensional space, a kind of common second derivative operator is the Laplace operator, Laplace expression at a point of a continuous function is:

$$\nabla^2 f(x, y) = \frac{\partial^2 f(x, y)}{\partial x^2} + \frac{\partial^2 f(x, y)}{\partial y^2} \quad (2)$$

When it comes to the digital image, we can also resort to some templates to calculate the Laplace value. But, the Laplace operator has two defects, one is to lose a edge direction information and the other is to double the influence of noise because the Laplace operator is a second difference operator.

Marr and Hildreth combine Gaussian filter and Laplace edge detection together, forming a LOG operator. First, we use a Gaussian function first to smooth the image, and then use the Laplace operator to calculate gradient value. So this operation smooths image as well as reduces noise and the isolated noise pixel and smaller structure organization will be filtered.

While applying a LOG operator, it is very important to select the variance parameter σ of the Gaussian function, which plays very great impact to the image edge detection precision. The Gaussian filter is a low pass filter, so the σ is bigger, and can repress of higher frequency noise, avoiding detecting the deceitful edge, but the image edge of pixel signal also smoothing and result in some edges point to lose. Whereas, the σ is smaller, can detect the detail of the high frequency of image, but the capability of repress noise drooped, and easily appear a deceitful edge.

The Canny operator is a optimization approach operator of three criterion such as signal to noise ratio, positioning precision, single pixel edge (Canny et al., 1986).

The Canny operator is according to optimization method, it adopts a Gaussian filter to carry on smoothing the image, so it has stronger capability of noise suppression control and can detect precise weak edge, as well the Canny operator will also lead to smooth some high frequency edge, result in losing edge information. The Canny operator adopted two thresholds algorithm to detect and link edge, it adopts many scale detection and directive search, so it better than the LOG operator, but it also increased complications of the algorithm in the meantime.

2.2 Experiment results

The edge detection effect of ellipse "fish scale body" by every edge detection operator is shown in Fig.1.

After Carrying out gray scale transformation, brightness correction and filter, the packaged grain image as figure 1(a) show. Then separately use Roberts operator, Sobel operator, Prewitt operator, LOG operator, Canny operator to detect edge of figure 1(a), results shown as figure 1(b)~(f). Obviously, the edge detection by the Roberts operator is coarse, handles the detail does not sufficient and omits a great deal of edge information. The edge detection effect of Sobel operator and Prewitt operator is similar, and

handle the detail isn't very good. By contrast, LOG operator and Canny operator handle the detail is better than other operators, but in the aspects of detected edge smoothing and connectivity, the Canny operator is obviously better than LOG operator.

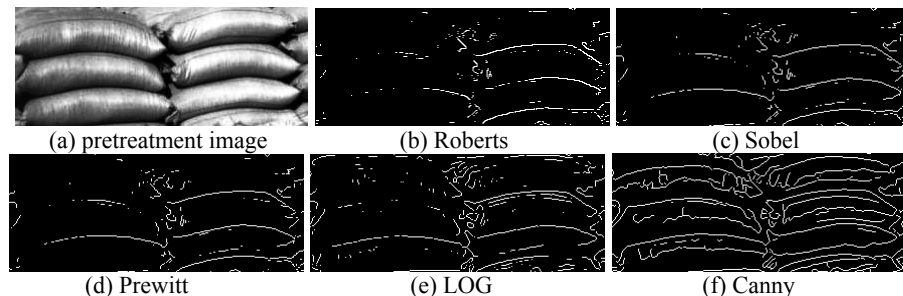


Fig. 1: Each operator edge detection result

In order to effectively detect the edge of the ellipse "fish scale body" of packaged grain image, the edge detection algorithm choose by us should be precision positioning edge as well as make the edge curve is as far as possible close, and easy to descript edge and fetch feature. Finally we select the Canny operator by experiments results, finally we choose the Canny operator to detect the bag food image. Though the Canny operator has better detection effect, but we see from the figure 1(f) that the ellipse "fish scale body" edge still isn't complete close, and has great quantities of deceitful edge, which make ellipse "fish scale body" of the edge description will can't carry on. The reasons for phenomenon are that the contrast degree of the gray image is lower; On the other hand, the image is complicated and has many target body. Therefore, if we only depend on an edge detection operator, the edge curve is very rare close.

Matheron proposed the Mathematical Morphology in 1964, then Meyer, Serra, Sternberg and other scholars spent a lot of energy on researching on the Mathematical Morphology, which has already become a kind of important means in the non - linear image processing (Fan et al., 2007). The Mathematical Morphology implements target feature extraction through selecting suitable structure element (probe), and its fundamental operations include dilatation and decay operation. The open and close operation is a compound operation combined by dilatation and decay operation. The close operation can clean the eyelet and fill up narrow split and long thin gutters and so on in the image edge region, which is suitable for getting rid of split of "fish scale body" edge to make edge is close. Because the Mathematical Morphology is according to the binary image, we must add image binaryzation operation to the image pretreatment. Aiming at the ellipse "fish scale body" shape character, we select a elliptic structure

element to carry on the close operation of the Mathematical Morphology in figure 1(a) which is binarization processed, then carry on a Canny edge detection, finally, we get the edge profile of "fish scale body" shown in Fig.2.



Fig. 2: Edge detection after close operation

3. "FISH SCALE BODY" EDGE DESCRIPTION RESEARCH

When it comes to describe the object which needed to be identify, we wish that we can a method which can provide more abundant detail information than a single parameter instead of image to describe the object. The image description can according to its internal feature, can also according to its exterior feature, so we can divide the description of image into the edge description (chain code, edge segmentation etc.) and region description (quad tree, skeleton etc.). Usually, edge description concerns about the shape feature of region in the image, but the region description is inclined to features, such as gray value, color and texture..etc. In the packaged grain automatic recognition, what we concern is the shape of the ellipse "fish scale body", therefore, we select edge description method to describe ellipse "fish scale body".

In the operation of identifying the ellipse "fish scale body", we request that strictly to carry on the statistics various characteristic parameters value according to the actual shape of ellipse "fish scale body", therefore, the accurate description edge of ellipse "fish scale body" is very important. The domestic and international scholars have already researched how to describe two-dimensional profile curve from different angles, and proposed various edge description methods.

Approximative polygon matching profile curve (Kong et al., 2001). The sixth reference proposed a new method which use approximative polygon of profile curve to express edge. There is many common methods such as based on contractive minimum circumference polygon method, based on polymeric minimum mean square error line segment approximation method, and based on split minimum mean square error line segment approximation method. In the digital image, many pixel points constituted edge curve. If each adjacent pixel points constitute a line, so we can use many line to accurately express edge. Obviously, this kind of method have excessive amount of computation and the real-time is worse. If we use discretization edge pixel points according to the certain algorithm to express edge, computation amount

decreases, but edge description precision consumedly descends, so this method is not suitable for the description of "fish scale body" edge.

Based on B Splines edge curve representation method(Cohen et al., 1995). The seventh reference proposed a new method which used B Splines to express edge. The advantage of this method is in consideration geometrical characteristic of profile curve to some extent. But sampling and fitting to the profile curve is a very complicated, so this method is not suitable for the description of "fish scale body" edge.

Edge chain code method. In 1977, Freeman firstly proposed 4 chain code and 8 chain code, so the chain code is also called Freeman code (Freeman H et al., 1977). The chain code method uses coordinates of edge starting point and point direction code of edge curve to describe a edge curve, and it is often used to express curve and edge region in the domain, such as image processing, computer graphics and pattern recognition etc. The method makes use of a series of particular length and connect with each other of direction line to express the edge of target. Because of length stationary and direction number finite of each line segment, only the starting point needs coordinates, other points can use direction to express an offset, so we can use a direction number to replace two coordinates numbers for saving bit. Obviously, the chain code can consumedly reduce the data quantity which edge representation needs. The chain code has some advantage such as simple, saving storage space, easy to compute, translation invariant and so on, so it is easy to the statistics characteristic parameter of close region.

There are many "fish scale body" in the packaged grain image, so we demand to carry on description and recognition for each "fish scale body", and need to adopt a calculate easily, small memory space, real-time high algorithm. The edge of "fish scale body" is a close curve, therefore, this paper uses chain code method to describe "fish scale body" edge.

The sampling of digital image is according to stationary spacing of the mesh, so the rule of the most simple chain code is to track edge and assign a direction value to each two adjacent pixels. The four directions and eight directions chain code is common (Gong et al., 2006), and the eight directions chain code increases four directions than four directions chain code. In the digital image, each pixel point has eight adjacent points, and the eight directions chain code corresponds with the practical situation, so it can accurately describe center pixel point and its adjacent pixel points information. In eight directions chain code, chain code along edge curve pixel points moves and codes by eight adjacency mode. two close together The offset of two adjacent pixels uses digit 0~7 representation. The code value add 1, the direction revolve 45° by inverse hour.

A edge curve can be only definite by the starting point and chain code of the edge curve. If curve S shows as Fig.3, and its chain code expresses by array Lianma[[]].

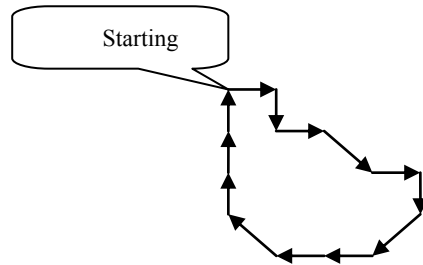


Fig. 3: Sketch of curve S

We take eight directions chain code to describe the curve S, then we get an array $Lianma[] = \{0, 6, 0, 7, 0, 6, 5, 4, 4, 3, 2, 2, 2\}$. Obviously, as long as any point coordinates and others chain code value are known, we can accurately describe the edge of region. For getting a integrated edge chain code of, and easy to follow-up operation, such as storing the chain code, feature extraction, reconstruction...etc. we can store the starting point coordinates, chain code and chain code length of curve in a table(Li et al., 2008). Chain code table type such as Fig.4 shows.

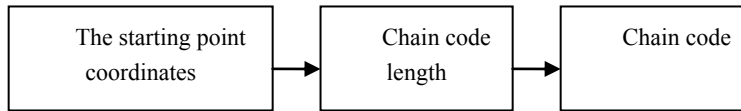


Fig. 4: Sketch of chain code table

The edge of an object can express by the coordinates of starting point and a sequence of direction code. Aiming at binary packaged grain image which carried on edge detection, we take the most top left corner of "fish scale body" edge profile which got by line scan method for the trail starting point, adopting eight directions chain code to traversal "fish scale body" edge. The algorithm steps of chain code tracks the edge of packaged grain image as Fig.5 shown:

We take Edge of image tracking operation for extracting the feature of object body in the image, such as the endpoint of edge curve, point of intersection, corner - point, centroid of close curve etc., in order to identify object body. After edge detecting the edge curve of ellipse "fish scale body" in the packaged grain image, we find that it looks like an ellipse. According to mathematical knowledge we can pass judgments as follows: (1) Establish an ellipse variance threshold, judge whether edge curve is a close ellipse shape or not. (2) If the edge curve is an approximate ellipse, we can take linear combination by a series of ellipse mathematics characteristic for the membership function to identify packaged grain image. The mathematics characteristic of ellipse has circumference, centroid, area, eccentricity etc., and these parameters very easy to get by edge chain code computation (Li et al., 2008). We can adopt linear combination of characteristic to identify the

ellipse edge of packaged grain image, to distinguish "fish scale body" on the different face.

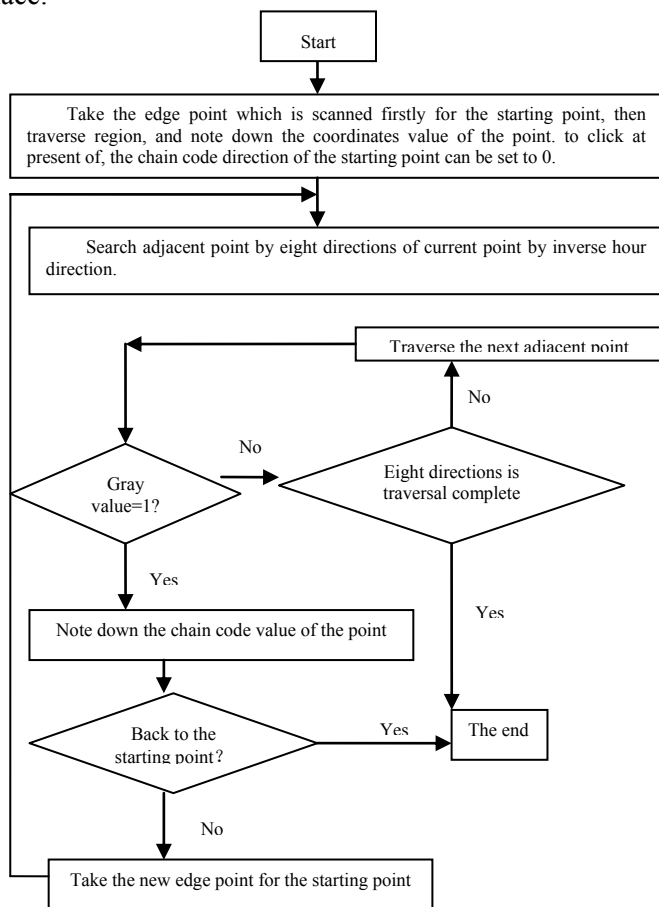


Fig. 5: Sketch of chain code method flowchart

4. CONCLUSION

In contrast, Canny operator is a well-defined operator, its definition strict, has high signal to noise ratio and detection precision, and the edge detection is more smoother, continuous, legible, so it is fit for edge detection of ellipse "fish scale body". Aiming at the detected ellipse "fish scale body" edge has a little incomplete occlusive character, this paper adopts the close operate of mathematical morphology to repair and link the edge nick. Finally, we get a complete close edge. Compared with other methods, Chain code method is simple, can reduce storage data and raise image processing velocity and

match efficiency, and have a translation invariant characteristic, so it is easy to statistics the characteristic parameter of the closed curve region.

This text combines Canny operator and edge direction chain code together used for packaged grain image edge detection and description of ellipse "fish scale body" in the image. Experiments show that this method can acquire good results. Accurate detection and description of the edge of "fish scale body" are the premise of recognition, the method proposed by this text satisfied the request of ellipse "fish scale body" edge recognition.

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