

Perimeter Calculation of Irregular Shapes Based on the Method of Translating Line Segments

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Abstract. Through image processing technology, programmers use instructions on a computer to identify the composition diagram of various molds. The automatic identification system device on the production line will identify whether the molds produced are qualified according to preset instructions, eliminating unqualified molds, fully realizing industrial testing automation, and quickly and accurately eliminating unqualified molds. This not only saves labor costs, but also avoids the subjectivity of manual testing. This paper proposes a method based on translation line segments to calculate the perimeter of irregular shapes. Translation refers to the movement of objects along a straight line in the same plane. This phenomenon is common in everyday life, such as children playing on slides in amusement parks, and the moving elevators of six supermarkets ascending or descending. Calculate the geometric feature parameters of the image area using the translation line segment method. According to the different appearance characteristics of the product, take photos of it from different angles and perform image processing, and comprehensively determine the required geometric feature parameter values. Calculate the geometric characteristic parameters of the product, and then compare them with the standard specifications. Conduct alarm marking processing for products that do not meet the requirements, facilitating manual removal.

Keywords: Translation line segment method, Irregular graphics, Perimeter calculation.

1. Introduction

The first step in image analysis and understanding is often edge detection, and good edge detection results are very important for image analysis. Therefore, it has become one of the most active topics in the field of machine vision research. The future development trend in industrial production is automation, and image processing technology is also needed in production. Compared with other forms of information, graphics have the advantages of being intuitive, clear, and rich in meaning, so it has a wide range of uses. Although the representation, generation, processing, storage, retrieval, and management of graphics are much more complex than text, using computers to process graphic information has taken a significant step forward compared to traditional manual or mechanical methods, making graphics more widely used, more effective, and less costly [1]. Traditional mold defect detection relies on human eye recognition. Although the human eye has a strong ability to identify patterns and can distinguish multiple patterns, in many cases, it is also difficult to avoid artificial fatigue and the invisibility of complex workpiece defects from the human eye.

Outer contour recognition is widely used in assembly drawing generation of engineering drawings. Automatic contour search and clipping algorithms are one of the methods to solve the hidden problem of two-dimensional assembly drawings in engineering drawings. Through image processing technology, programmers use instructions on a computer to identify the composition diagram of various molds. The automatic identification system device on the production line will identify whether the molds produced are qualified according to preset instructions, eliminating unqualified molds, fully realizing industrial inspection automation, and quickly and accurately eliminating unqualified molds. This not only saves labor costs, but also avoids the subjectivity of manual inspection [2-3].

This paper proposes a method based on translation line segments to calculate the perimeter of irregular shapes. Translation refers to the movement of objects along a straight line in the same plane. There are many such phenomena in life, such as small friends playing on slides in amusement parks, and the moving elevators of six supermarkets ascending or descending. Take photos of each product

regularly and perform automatic processing [4]. Since the translation line segment method provides edge information of the image at each scale, it is called multi-scale edges. Connecting edge points at any scale along each boundary direction can form a modulus maximum curve along the boundary at that scale. For the identification of internal contour lines, it is necessary to interactively provide a point within the contour to be identified. Starting from this point, make a ray to the left and intersect with the line segments on the view to find the closest intersection point. Then, the directed line segment is the starting search edge, and the internal intersection point is the starting search point [5]. Calculate the geometric characteristic parameters of the product, and then compare them with the standard specifications. Conduct alarm marking processing for products that do not meet the requirements, facilitating manual removal.

2. Image processing flow

2.1. Image preprocessing

In practical application, due to noise, illumination and other reasons, the quality of the original image obtained by the system is not high, so it is necessary to denoise and enhance it to extract the interested information. For a view, the outer contour is unique. First, we should find the lower left point in the view. If the lower left point is the inner point of the arc, the uniqueness of the arc can easily determine the starting search point and the starting search edge [6]. When the image denoising is realized, some original details of the image will be destroyed, making some images unclear and unable to perfectly remove the noise in the image. Median filtering is a nonlinear processing technology, which is widely used in digital signal processing, because in the actual operation process, it is not necessary to know the brightness, chromaticity and sampling value of the image in advance, and it has unique filtering characteristics.

Image enhancement processing includes image equalization, sharpening and so on. Image processing can be realized in both spatial domain and frequency domain. In this paper, the gray value of pixels on the image is changed mainly by point operation in spatial domain. Find all other line segments connected with the current search point. These line segments are collectively called candidate edges. If the new search point is not the endpoint of the candidate edge, the candidate edge is divided into two segments, both of which are candidate edges, and the other endpoint of the line segment becomes a candidate point. If all these line segments are regarded as directed line segments, the starting point is the lower left point, and the directed line segments are cross-product, then there must be and there must be a directed line segment whose cross-product with other directed line segments is negative, then this edge is the initial search edge and the lower left point is the initial search point [7].

2.2. Contour tracking

The area can also be described by multiple horizontal line segments, which are obtained by scanning marking method. At this time, the line segment table structure is used to store the area information. The line segment table consists of an endPoint table obtained by arranging all horizontal line segments in the region in scanning order. Each endpoint is represented by a point structure, and two adjacent endpoints represent one horizontal line segment. Start from the current search point and find the first point on the search edge along the direction of the current search edge. This point may already exist in the graphic data file, or it may be a new point, that is, the intersection of product line segments [8]. Scan the whole image line by line. If you encounter an object point of a binary image, you can start 8-connected tracking with this object point to complete the tracking of a single area, and fill in the chain code table when tracking. Because the chain code table cannot directly distinguish the inside and outside of the region, the candidate point with the smallest position value among the candidates is found as the preferred point. If there is only one preferred point, the candidate edge where the preferred point is located is the sought edge, otherwise, the processing continues. The

conversion table can be used for the conversion from chain code table to line segment table, and its structure is shown in Table 1.

Table 1. Conversion Table

Incoming chain code	Departure chain code			
	0	1	2	3
0	0	0	0	2
1	1	1	1	0
2	1	1	1	3
3	1	1	1	2

During the acquisition process, images can be affected by noise such as cameras. Wavelet modulus maxima performs multiscale edge detection while effectively suppressing noise, meeting the dual requirements of noise suppression and accurate edge positioning. If a smaller filter is selected in the preprocessing, an image acquisition card is used to collect the output signal waveform of the object under test, and histogram is generated after data processing, Find the threshold level from the histogram. The second method is most commonly used, selecting the appropriate threshold level. This allows the image to produce less blurring effects, so it is possible to detect smaller and more varied thin lines. Similarly, selecting a smaller filter in the preprocessing process produces more blurring, which is used to detect larger images as a whole [9]. The boundary points in an image generally form a curve, which is usually the boundary of some important structures. By connecting the wavelet modulus maximum points, a maximum curve along the boundary is formed.

3. Research on perimeter calculation of irregular graphics based on translation line segment method

3.1. Analysis of perimeter change

The perimeter of a figure is the length of a circle around it. If we solve it according to this idea, we can find the length of each line segment one by one, and then add it up. Usually, the geometric characteristic parameters of the target area mainly include perimeter, area, shape factor, center of gravity, circumscribed rectangle and so on [10]. These parameters can be easily calculated by using chain code table and line segment table. If the line segments at the outer edge of the figure are added segment by segment according to the definition of perimeter, the final perimeter can be obtained. However, this method is cumbersome and prone to errors. Judge whether its center is on the right side of its center direction, if so, the arc is the desired point, otherwise, delete it from the preferred point. If there is only one preferred point after deletion based on the translation line segment method, the candidate edge where the point is located is the sought edge, otherwise, processing will continue. According to the selection of reference edge, the included angle between the two sides must be acute, so the greater the cosine value, the smaller the angle, so the candidate edge corresponding to the maximum cosine value is the sought edge. The flow chart of the search process is shown in Figure 1.

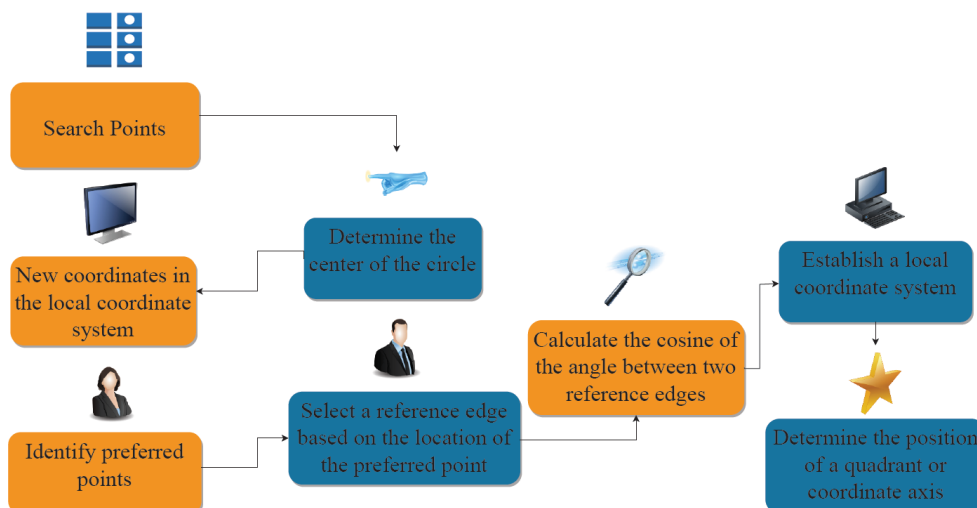


Figure 1. Search process flowchart

The determination method of the basic formula is to see whether the obtained number in this formula can be substituted into other formulas. The target image is separated from the background and marked with "0" and "1" respectively, in preparation for geometric feature extraction. In order to obtain ideal binary images, threshold segmentation techniques are commonly used, which can effectively segment images with strong object and background pairs. If it cannot be replaced, this formula is usually the basic formula, and the basic formula is often placed at the end of these several formulas.

3.2. Center of gravity of the area

The center of gravity of the region is actually the center point of the target region, also known as the center of area, which is the centroid of a graph with constant mass. The center of gravity of a region is a basic feature of the region and a descriptor of the image. The coordinates of the center of gravity of the region are calculated based on all the points in the region. The details of edges at various scales are also different. The higher the scale, the less detail, which is the advantage of multi-scale. Due to the excessive omission of details, the contour shape is deformed, resulting in distortion, which is not conducive to accurate measurement of gear parameters. The grayscale processing of an image is the process of converting a color image into a grayscale image. By graying the image using the translation line segment method, the interference of image color can be removed, making preparations for the subsequent geometric feature extraction of the image. Place the mouse at the position where the contour line needs to be closed, and double-click the left mouse button twice continuously. The program performs automatic recognition processing to form a closed contour line. Click the "F" icon on the software running interface to automatically identify the graphical contour lines, and then obtain the best graphical contour lines.

Calculate the geometric feature parameters of the image area based on the translation line segment method. According to the different appearance characteristics of the product, take photos from different angles and perform image processing, and comprehensively determine the required geometric feature parameter values. For binary images, the center of gravity of the target area can be directly calculated, but in actual grayscale images, the first method does not take grayscale changes into account. A method for calculating the center of gravity of a target area based on the geometric moments of the translational line segment method. Even if the gray level in the target area changes, the center of gravity can still be calculated.

4. Conclusions

Image processing has many applications in intelligent control, intelligent monitoring and industrial automation of robots. With the development of intelligent equipment, it brings a lot of convenience

to people, but the accuracy of calculation and the robustness of the algorithm need to be further studied. If there is only one preferred point after deletion based on the translation line segment method, the candidate edge where the point is located is the sought edge, otherwise, processing will continue. According to the selection of reference edge, the included angle between the two sides must be acute, so the greater the cosine value, the smaller the angle, so the candidate edge corresponding to the maximum cosine value is the sought edge. Multi-resolution edge detection algorithm has stronger ability to obtain different levels of edge information according to different needs, which solves the problems of poor effect and low recognition value of traditional edge detection algorithm and provides technical support for high-precision detection of gear parameters. In this paper, the image is processed based on the translation line segment method, which can accurately measure and calculate the geometric characteristic parameters of the image, and the geometric characteristic parameters of the image area are calculated based on the translation line segment method. According to the different appearance characteristics of products, they are photographed from different angles and processed, and the required geometric characteristic parameters can be comprehensively judged. The center of gravity of the target area is directly calculated by translating the line segment, but in the actual gray image, the first method does not take the gray change into account. Although there are few test objects, it can explain its feasibility and accuracy to some extent.

References

- [1] Huang H, Chen X, Liu J, et al. A theoretical calculation method of irregular bridge span pontoon connected by elastic hinges[J]. *Marine Structures*, 2021, 76(30):102929-102946.
- [2] Zhang L, Ren L, Hao X, et al. QUERY METHOD FOR NEAREST REGION OF SPATIAL LINE SEGMENT BASED ON HILBERT CURVE GRID[J]. *International journal of innovative computing, information and control*, 2022, 65(4):15-38.
- [3] Liao Y, Xiao W, Wu Z. Improved algorithm for calculating electric field in microwave applicators of irregular shapes with elements in translation[J]. *International Journal of RF and Microwave Computer-Aided Engineering*, 2022, 29(18):47-58.
- [4] Garanin S M, Danilov I N, Raevskii S B, et al. The Method of Integral Equations for Calculation of Smoothly Irregular Out-of-Line Waveguide Transitions[J]. *Journal of communications technology and electronics*, 2019, 63(4):64-77.
- [5] Jin D, Guo H, University B J. Calculation method of site perimeter volume ratio based on ideal point method of Matlab model[J]. *Shanxi Architecture*, 2022, 41(19):38-57.
- [6] Zheng P, Lou J, Lin D, et al. Descending Packing Algorithm for Irregular Graphics Based on Geometric Feature Points[J]. *Mathematical Problems in Engineering*, 2020, 20(15):1-12.
- [7] Tu P, Lischinski D, Huang H. Point Pattern Synthesis via Irregular Convolution[J]. *Computer graphics forum: journal of the European Association for Computer Graphics*, 2022, 56(12):37-62.
- [8] Ma Y, Chen Z, Hu W, et al. Packing Irregular Objects in 3D Space via Hybrid Optimization[J]. *Computer Graphics Forum*, 2021, 37(5):49-59.
- [9] Zhou X D. Using Monte Carlo Method to Solve the Area of Irregular Graphics[J]. *Management & Technology of SME*, 2022, 18(3):36-42.
- [10] Berry L, Beveridge A, Butterfield J, et al. Line-of-Sight Pursuit in Monotone and Scallop Polygons[J]. *International Journal of Computational Geometry & Applications*, 2019, 29(4):307-351.