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Research on Detecting Taper Thread Based on Digital Image Processing Technology of Feature Detection

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ABSTRACT. *Digital image processing and analysis technology has been rapidly developed and widely used in today's digital information age, and has shown an important position. Digital image processing technology mainly includes image binarization, edge detection, contour extraction and thread geometric parameters calculation. At the same time, the points on the boundary are sorted, and the transition points in the boundary feature points are detected. Finally, the point boundary polygon is constructed. In the feature description stage, the local features are described, and the image is digitally processed in the computer to obtain the contour of the thread, thereby calculating the geometric parameters of the thread and improving the fidelity of the image quality, which is generally called image restoration technology. Feature detection not only has good matching performance, but also has a lower dimension, which is very beneficial to improve the matching speed of image features. Image enhancement techniques will be used primarily in the pre-processing of tapered threads to improve image quality.*

KEYWORDS: *FEATURE DETECTION; DIGITAL IMAGE; SCREW THREAD*

1. Introduction

The computer processes the image, analyses and recognizes it, and finally obtains all kinds of detection data. So this non-contact detection technology can also be called precision measurement technology based on digital image [1]. There is a one-to-one linear relationship between the conical thread contour image (expressed in pixel points) and the actual size (expressed in millimeters), that is, the measurement ratio between the two is constant, which is determined by the magnification ratio of the camera lens and the amplification ratio of the CCD device [2]. Generally speaking, extracting local features can be divided into two key steps:

feature detection stage and feature description stage. The task of feature detection stage is to locate key points, feature scales and their main directions in scale space [3]. When the quality of the thread is very poor, the tester will be overwhelmed and do not know where the problem is. At the same time, for the inspection of large quantities of thread, it takes time and effort, the detection accuracy is not high, and automation cannot be realized. The system for detecting thread parameters using digital image processing technology consists of a CCD image sensor, an image acquisition card, a light source, a fixture, and a computer [4]. The original image is processed by the feature detection operator, and the edge point data of the image is detected and processed to obtain the geometric parameters of the object. According to the measurement mathematical model and measurement requirements, the measurement results of the part collection parameters are calculated and processed [5].

Due to the continuous improvement of digitalization, automation and measurement accuracy of measurement equipment, the measurement data of the model shows a rapid growth trend. In spatial domain, mean filtering or median filtering are often used for image smoothing [6]. Mean filtering is a neighborhood operation through template operation, that is, the result of a pixel is not only related to the gray level of the pixel. Thread parameter detection system uses software image processing system, which uses general hardware, large market, good technical support, high performance-price ratio, and can easily update one of the components [7]. Continuous image processing is transformed into digital image, and then binarization, median filtering and feature detection are performed to extract the contour of threads. For the same image local structure, the algorithm extracts many repetitive features, and these features are only slightly different in position and scale [8]. This large amount of repeatability increases the mismatch rate and the complexity of the matching calculation. The main problem with mean filtering is that it may blur the sharp discontinuities in the image, but the nonlinear filtering algorithm can both eliminate noise and preserve the details of the image [9]. Median filtering is the simplest nonlinear filtering. The basic idea is to replace the gray value of the pixel with the median value of the gray value of the neighborhood of the pixel. Various target image feature values, and thus realize various functions such as pattern recognition, coordinate calculation, and grayscale distribution map. Compared to artificial vision, the biggest advantages of machine vision are accuracy, speed, reliability, and digitization [10].

2. Materials And Methods

The edge of an image is the most basic feature of an image. The edge points refer to those pixels whose gray scale of the surrounding pixels changes step by step or the roof changes, that is, where the derivative of gray value is larger or larger. For some point data with no closed boundary, if the points on the boundary are similar to the attributes of the points around it (for example, they are actually in the same plane). Therefore, some noise can be filtered out, but the image has a certain degree of ambiguity. Reducing image ambiguity is one of the main problems in image

smoothing, which mainly depends on the characteristics of noise itself. Software writing can develop flexible and applicable image processing algorithms, and process the measurement data in a rich way. The results of the analysis are fed back to the control system as required and coordinated with various communication, control and detection components. In the feature description phase, we calculate the distance and direction histogram of the gradient in a circular area around the feature point and create a descriptor. The feature detection operator examines the neighborhood of each pixel and quantifies the grayscale rate of change, which typically also includes direction determination. Therefore, a certain noise is filtered out, but the image has a certain degree of ambiguity, and reducing image blurring is one of the main problems of image smoothing processing, which mainly depends on the characteristics of the noise itself.

Thread angle is defined as the angle between the side of the thread. Thread angle is the measurement of the angle between the tooth angle and the thread angle by measuring the side angle. Thread side angle is the angle node between the side of the thread and the vertical plane of the thread axis. Continuous partitioning generates new leaf nodes, and point data in parent nodes are also partitioned into child nodes. Whether a node is partitioned depends on the number of points in the data contained in the node. The feature detection operator checks the neighborhood of each pixel and quantifies the gray change rate, including direction determination. Then the edge is extracted by convolution method based on directional derivative mask. Searching for local 3D extremum points on the scale space, and determining the position and scale of the local features, and then accurately positioning the position and scale by fitting the 3D quadratic function, while removing low-contrast feature points and unstable Edge response point. Each point in the image is convolved with the two cores, one with the largest vertical edge and the other with the horizontal edge. Using a template window with an odd number of points, the center of the window is coincident with the pixel to be processed in the picture, the gray value of each corresponding pixel under the template is read, the gray level is sorted from large to small, and finally the median value of the sequence is taken. Instead of the value of the center pixel of the template. The photogenerated charges are accumulated and stored in the wells of the cells isolated from each other, and the number of signal charges accumulated in each of the pixel wells is proportional to the product of the average illuminance and the light integration time irradiated on the face of the cells.

The local operator method of feature detection is a method that inspects the gray level change of each pixel in a certain neighborhood, and extracts the contour edge by using the first or second derivatives of edge adjacent. In the actual image processing process, these degraded images must be improved. Generally, there are two ways to improve the quality of images. One is to highlight the features of interest selectively without considering the reasons of image degradation, and the other is to compensate for the reasons of image degradation. Essentially, image edge is a reflection of the discontinuity of image local characteristics (gray level mutation, color mutation, etc.). It marks the end of one region and the beginning of another region. The disadvantage of the operator is that the extracted features are not always

stable. Because these extreme points may be located on the edge of the brightness change in only one direction, such points are vulnerable to noise or small texture changes. Its purpose is to try to choose the best threshold to minimize the error between the detected object and the background segmentation in the image. These target areas generally have their own specific properties such as grayscale, texture, and the like. Image segmentation is based on the different characteristics of the image in each region, and it is segmented on the boundary region, and the target of interest is extracted from it. Points can be distributed in each subtree rather than just sibling nodes under the same parent node. Therefore, when designing the structure of a node, special fields are needed to record the neighbor relationship between nodes. The spatial unit adjacency relationship is shown in Figure 1.

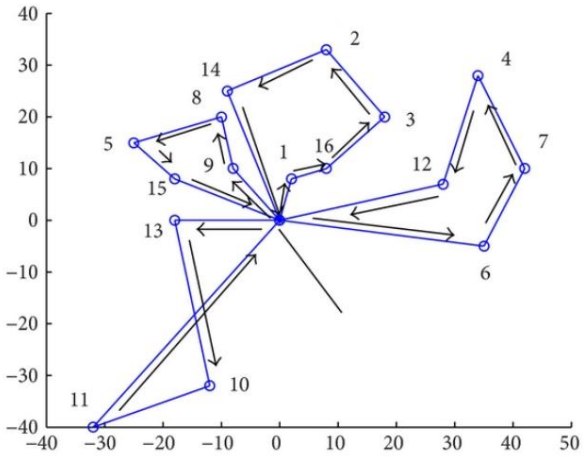

Figure. 1 Adjacent Relations of Spatial Elements

3.Result Analysis and Discussion

After detecting the boundary feature points, the disordered feature points should be sorted, and the disordered points should be arranged in the form of polygons, so as to have practical significance for the subsequent solid modeling. Local discontinuities are detected, and then they are connected together to form boundaries that divide the image into different regions. Because of different kinds of images and different application occasions, the image features need to be extracted are different, of course, the corresponding image feature extraction methods are also different. The edge of an image is the most basic feature of an image. The edge points refer to those pixels whose gray scale of the surrounding pixels changes step by step or the roof changes, that is, where the derivative of gray value is larger or larger. The descriptor is also based on the idea of neighborhood gradient statistics of feature points to enhance the anti-noise ability of the descriptor and the fault tolerance of

positioning errors. The goal of establishing a new descriptor is to maintain the dimension. The arithmetic of extracting edge is to detect the mathematical operators of edge pixels which accord with the characteristics of edge. Firstly, the image is Fourier transformed, and then the frequency spectrum fcr of the image is modified, such as filtering, and transformed back into the spatial domain c0, thus achieving the purpose of enhancing the image. It is an indirect processing method. The frequency domain enhancement model is shown in Figure 2. If the image only includes background and objects, then the histogram shape is two peaks and one valley, and the threshold value at the valley bottom is the most appropriate and the error is the smallest. For targets with certain characteristics, the specific position of the target positioning reference point on the target must be clearly defined.

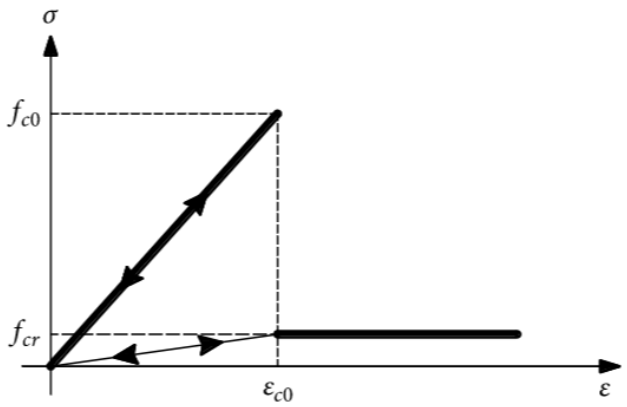

Figure. 2 Frequency domain enhancement model

Identify and determine the most consistent position with the target features. In the process of analysis and location, floating-point arithmetic can be used to locate the target with better accuracy than the whole pixel. Thread histogram is almost not disturbed by noise. It is an ideal shape with two peaks and one valley. Therefore, the value area of valley bottom can be found intuitively on gray histogram, and the threshold value can be determined accordingly. The center of the feature detection operator corresponds to the central pixel, and the convolution operation is carried out. The maximum value of the two convolution kernels is the output bit of the point. The purpose of weighting is to reduce the influence of points far from the center. Then, each gradient direction is rotated to the main direction to ensure rotation invariance. The gray histogram of the conical thread image is hardly disturbed by noise. It is an ideal shape with two peaks and one valley. Therefore, the value area of the valley bottom can be found intuitively on the gray histogram, and the fitting line can be used in calculating the pitch, because the intersection point of the straight line is needed for calculating the pitch. In the calculation of the middle diameter, we use the standard taper as the slope of the medium diameter line, mainly considering that the taper is often affected by actual damage or dirt, the change is relatively large,

the measurement taper itself has errors, and each gradient point is calculated. The distance from the center point. The size of the threshold can be determined according to the spatial complexity of the point data boundary, due to the complexity of the actual object boundaries.

There will be two separated peaks in the histogram of the image. For such an image, the gray value corresponding to the valley between the two peaks of the histogram can be selected as the segmentation threshold. According to the uniformity of the projection point, whether the point is a boundary feature point or not is judged. If the point is marked as a boundary feature point, the point can be retained by weighting method. Fixed-size templates roam through the image, overlap the template with a pixel position in the image, read the gray values of the corresponding pixels under the template, sort the gray values from large to small, and finally take the median of the sequence to replace the value of the central pixel of the template. The feature points may be unstable, because the detected extreme points may fall near the edge of the brightness signal which only changes in one direction, which makes the detected feature points sensitive to noise interference or subtle texture changes. The basic idea is to replace the pixel gray value with the median value of the gray value of the neighborhood of the pixel. The distribution map of each gray value in the image is drawn by counting the proportion of pixels occupied by each gray value in the image, thereby determining the threshold for dividing the object and the background. There are two ways to specify the thread tolerance: “per inch” and “accumulation”. The tolerance within the cumulative length of the measuring pitch can reduce the error of the single pitch, but measuring the single pitch can see the variation of the pitch along the bus.

4. Conclusion

In this paper, the method of detecting taper thread based on digital image processing technology of feature detection is studied. In the process of extracting the edge target of thread geometric parameters, according to the general principle and method of image measurement, the least square method is used to fit the boundary, and the geometric parameters of thread are extracted by geometric calculation. The characteristic of edge is that the change of pixels along the edge direction is gentle, while the change of pixels perpendicular to the edge direction is intense. According to the broken surface of threads, two-dimensional coordinate positioning is carried out, and then the screw image morphology judgment function is completed. The application of digital image processing technology in thread detection enables automatic detection of threads. And the least square plane composed of the neighborhood of the data points is used to calculate the angular standard deviation threshold of the projection point, thereby determining the boundary feature points of the point data, and even better performance under some transformation conditions, such as small viewpoint transformation and illumination change, and More importantly, the dimension of the feature vector is lower, which is very beneficial to improve the speed of image feature matching. The point of abrupt changes is removed by a point and a few points around it (usually an averaging operation) to

filter out certain noise, but the image has a certain degree of ambiguity, and reducing image blurring is one of the main problems of image smoothing.

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