Research on calculation strategy of perimeter of irregular objects

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Abstract. Image processing is a burgeoning subject in recent decades, which combines related theories with modern high technology to systematically study various image theories, technologies and applications. In the problem of industrial precision dimension detection, the edge of the obtained target image is rough and noisy due to the manufacturing accuracy, breakage and corrosion of the workpiece, which makes automatic detection difficult. Therefore, it has become a difficult problem to accurately extract the characteristic curve of the target edge in the development of industrial automatic detection system. Image measurement method has the advantages of non-contact, high speed, large dynamic range and rich information, and is widely used in the field of measurement. This paper introduces the principle of foot type three-dimensional contour measurement based on the light cutting method. Aiming at the composition of a multi CCD light cutting measurement system, a new method for high-precision extraction of the center line of the contour light band using the combination of central axis tracking and improved deflection measurement principle is proposed. The extraction and processing process of the light cutting surface contour image is described in detail, and through the coordinate transformation of the extracted center line, The complete profile data of the foot profile are obtained. The experimental results show that the processing effect of this method is satisfactory.

Keywords: Irregular objects; Perimeter calculation; Image processing.

1. Introduction

Vision is the main means for people to know the world. According to statistics, more than half of the information received by human beings comes from vision. Image is the reflection of human beings on objective things. With the continuous development of control theory, analytical methods and computer technology, image processing technology has also developed rapidly [1]. From a technical point of view, image processing is a general term for various technologies related to vision. Therefore, image processing science and technology are powerful tools in this field. From the perspective of research methods, this discipline and optics, physics, mathematics, physiology, photography, electronics, computer technology and other disciplines learn from each other [2]. At present, image processing and analysis technology has been widely used in office automation, industrial robots, geographic data processing, medical data processing, geological exploration, remote sensing, artificial intelligence and industrial detection. With the further development of image processing and analysis technology, its application scope is also expanding [3].

In the 21st century, with the rapid development of the economy, the demand for wood resources is increasing day by day. In the face of this situation where the supply of wood is in short supply, an effective solution is to improve the utilization rate of wood through comprehensive utilization, such as using leftovers from the wood processing process to produce plywood, fiberboard, etc. The utilization rate of fiberboard for wood is as high as 90% or more. Composite boards have many characteristics that pure wood does not have, such as uniform structure Consistent strength, strong compression resistance, wear resistance, thermal insulation, and resistance to deformation [4]. The size and shape of filler particles are the most important physical characteristics of powder, which have a direct impact on the powder's fixation, cohesion, fluidity, filling and packing density. Particles with different sizes and shapes have great differences in sphericity, roundness, smoothness and other aspects, which directly affect the interaction between particles, and affect the physical properties, chemical properties and artistic properties of materials made of particle powder, such as stability,

corrosion resistance, elasticity, bending resistance and mechanical properties [5]. The application of computer has gradually expanded from the fields of numerical calculation and data processing to the fields of information processing and knowledge processing. The emergence of computer graphics, a new branch discipline, is an example of the mutual promotion of computer application and computer technology [6].

The mining output of middling coal in the industrial production process is the main indicator to measure the energy economy, which requires the volume of coal to measure the economic benefits of the coal mine, but it is difficult to obtain the volume parameters of middling coal in the actual production process [7]. In the process of coal mining, the coal mining device will have a corresponding conveyor belt. If the volume of coal can be directly measured during the process of coal output from the coal mine, the volume of coal mined by the entire system can be obtained. This volume calculation idea can simplify the operation steps in the industrial production process and improve the economic benefits of the coal mine. Computer vision refers to the use of computers to simulate human visual functions. In reality, objects are three-dimensional, and binocular vision has inherent advantages in capturing three-dimensional information. This topic introduces a volume measurement method based on binocular stereo vision. Aiming at the above typical scenes, designing a volume measurement method for irregular objects will greatly reduce measurement costs and improve measurement efficiency, Meet the volume measurement of different target objects in different scenarios [8].

The research task of this paper is to solve the volume measurement problem of irregular objects by binocular system. According to the traditional idea that the volume is equal to the bottom area multiplied by the height, the image of the object to be measured is collected by binocular system, and the image processing, stereo matching, depth calculation and subsequent volume solution are carried out by computer. Two stereo methods based on semi-global stereo matching algorithm and minimum cut algorithm based on graph theory are used to measure the three-dimensional information of objects by using two-dimensional images.

2. Research on perimeter calculation strategy of image preprocessing

2.1. Measurement principle and system calibration of binocular vision system

Stereoscopic vision measurement systems are modeled after human vision systems, and obtain three-dimensional information in real space through the processing and calculation of two-dimensional images. They belong to the field of computer vision research. Vision-based measurement methods are usually non-contact, with short measurement time, high accuracy, and the ability to obtain rich three-dimensional information. With these advantages, as well as improved camera performance and software performance, the advantage of visual measurement is further highlighted as one of the most effective means to achieve on-site and online measurement [9]. The traditional method for measuring the positional degree of a hole system is to use a special comprehensive gauge for inspection. However, the special comprehensive gauge inspection can only be qualitative measurement and cannot determine the direction. There are certain difficulties in incomplete arcs and some complex curves, which cannot meet the expected requirements. CMMs use coordinate measurement methods to detect the positional accuracy of parts. They can edit measurement programs to achieve automatic measurement of the positional accuracy of parts, effectively reducing human error. According to the machining benchmark on the part, CMMs can automatically establish a three-dimensional correction coordinate system, easily measuring the positional coordinates of each hole or shaft on the part, and calculating the positional accuracy. It uses the image of the measured object as a carrier of information, extracting useful information from it to achieve measurement purposes [10].

Image measurement method has the advantages of non-contact, high speed, large dynamic range and rich information, which has attracted the attention of measurement fields at home and abroad. Usually, when collecting images, the information will be incomplete or distorted due to environment,

noise and random factors, so it is necessary to denoise and enhance the original image to minimize the influence of external factors on the image. Image information is mainly concentrated in the low frequency part. Using low-pass filtering algorithm can remove high-frequency interference and ensure low-frequency information at the same time. After low-pass filtering, although the image has become very smooth, there may still be some big noises, so enhancing the image has become an important research direction. The basic process of image measurement is that the collected digital images are processed and calculated by computer processing technology to extract the elements that need to be measured in the images; Then the processed image is analyzed and the measurement results are output. As shown in Figure 1.

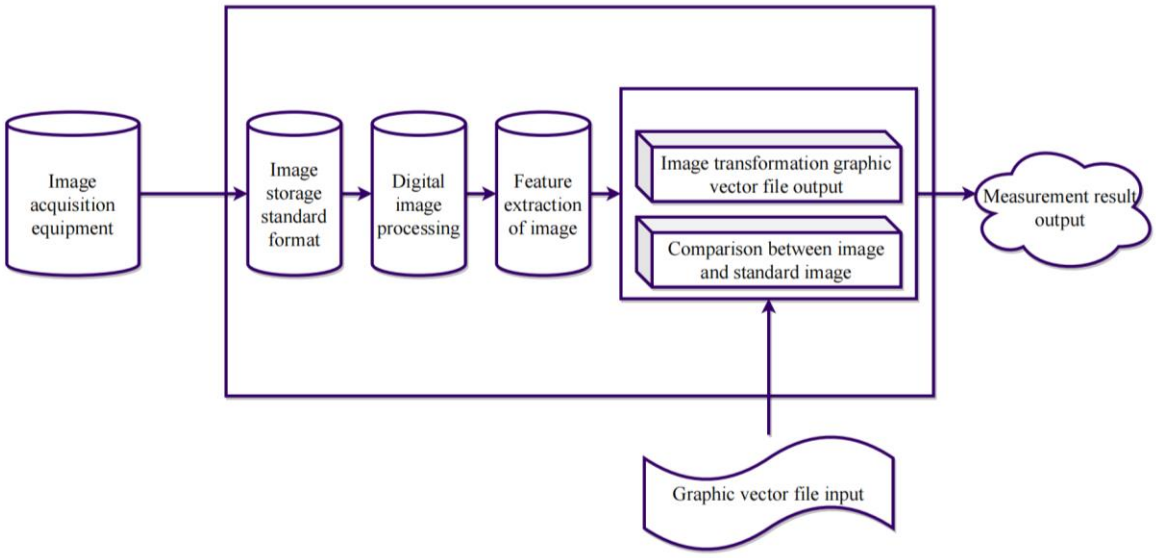

Figure 1. Frame diagram of image measurement system

Irregular object volume measurement uses a binarized image from the top view to divide the object left and right, and uses image segmentation methods to detect objects from the left and right views. The height of pixel points is reconstructed using a three-dimensional recovery method within the target area, and the height of pixel points is assigned to zero outside the target. During the three-dimensional recovery process, the main purpose is to reconstruct the target in the image, but the background is irrelevant information. Therefore, if all pixels in an image are calculated, it will increase the computational complexity to a certain extent, which not only wastes the storage resources of the computer, It also increases recovery time.

2.2. Image acquisition and processing technology

The first step of image measurement technology is image acquisition. There are many ways of image acquisition, which can be through digital cameras, cameras and scanners. Digital camera has high resolution and can achieve high precision, but it is complicated to transmit data with computer and takes a long time to process data. It is convenient to connect the camera with the computer, and the speed of data processing is fast, which can achieve the effect of real-time processing, but the resolution of the image is low, which can not meet the accuracy requirements. In the actual detection process, no matter in the industrial field or the laboratory simulation environment, there can be no ideal detection environment without any interference, so the images collected in the detection process will inevitably be noisy, and the collected images will also be affected and interfered by various noises during transmission and storage. Therefore, before all kinds of image processing are carried out on the collected images of the parts to be measured, appropriate methods should be adopted to reduce the image noise. The most common method is to use digital filters, and the filtering effect will directly affect the measurement accuracy. The optical part of digital camera is the same as that of traditional camera, some use zoom lens, some have flash, and generally adopt autofocus.

Because digital cameras require operations such as CCD to read images, check the auto focus, adjust the aperture, and change the shutter speed, it takes about 1 second to truly image after pressing the shutter. "These segments are considered as directed segments, with the starting point being the lower left point. If the directed segments are intersected in pairs, there must be and must be a directed segment whose cross product with other directed segments is negative, then this edge is the starting search edge, and the lower left point is the starting search point.". For the identification of internal contour lines, it is necessary to interactively provide a point within the contour to be identified. Using this point as the starting point, make a ray to the left and intersect with the line segment on the view to find the closest intersection point. Then, the directed line segment (starting point is the given internal point, ending point is the closest intersection point) is the starting search edge, and the internal intersection point is the starting search point. For example, when taking pictures with a camera or using digital products, Gaussian noise often forms on the image due to the characteristics of physical devices and electromagnetic reasons of electronic imaging systems; Pulse noise caused by sudden changes in the signal at a certain point due to environmental interference during image acquisition or shooting. In order to perform subsequent processing on the image, it is necessary to perform noise reduction processing on the image.

3. Research on the Perimeter Calculation Strategy of Irregular Objects

3.1. Data collection and analysis

The collection of image data is mainly to analyze the processed images in digital form. There are two main methods, one is to manually select the points on the image, and then fit them into straight lines or arcs according to the points manually collected with the cursor on the screen, and the other is to manually select the starting point and ending point of the collection, and the other points are automatically collected by the computer. The key of image measurement technology is image data processing and analysis system. For the size of position, there are several algorithms for extracting entities: fast extraction of center coordinates based on Hough transform, least square fitting of center and radius of plane circle, thinning method and orthogonal scanning method. The least square algorithm is ideal. A straight line or curve is formed by least square fitting, and the position degree is evaluated. For the evaluation of profile, the collected points can be compared with the input CAD graphic file, or the collected points can be output to the CAD file and evaluated by CAD software. This step is also implemented using VB language. This allows the measurement of the image to be completed. However, there are still some issues that need to be addressed when applying image processing technology to online inspection, such as differences in image acquisition conditions, differences in specific image processing implementation algorithms, and defects in completely relying on single factor indicators to evaluate inspection results, which result in low reproducibility, accuracy, and reliability of the evaluation results. The idea of image segmentation is to distinguish mutually unrelated regions based on some features. The information correlation of each different region is low, while the information correlation of the same region is high. In a volume measurement system, the main purpose of image segmentation is to detect the target area in the left and right views, assign a value of zero to the pixel points outside the image area, and perform a high degree of restoration of the pixel gray value within the area.

Generally, there are four methods for image segmentation based on different criteria, namely, edge detection using edge features, threshold segmentation based on pixel value size, region initialization based on region as a unit, and partial differential equation method. The threshold method is suitable for situations where there is significant contrast between useful information and irrelevant information in an image. By directly selecting a threshold value, it is simple and intuitive to achieve, especially for images with significant differences between useful and irrelevant information, efficient and accurate segmentation results can be achieved. The determination of the threshold value is mainly based on the gray level histogram of the image, ignoring the spatial position correlation of pixel points, and when there is noise, it is extremely easy to obtain incorrect segmentation results, If the gray level

difference in the image is not obvious or there are different intensities and angles of illumination in the image, even if there is only one target, there may be inaccurate segmentation.

The shape of an object can usually be described by four methods: height value, surface normal vector, gradient, inclination angle and deflection angle. In this paper, the gradient representation method is mainly used, that is, $(p,q)=(\partial z/\partial x,\partial z/\partial y)$, which means the change rate of any point on the surface of the object in two directions, where $z=z(x,y)$. The principle of SFS is shown in Figure 2 below, where θ is the included angle between the incident direction of the light source and the surface normal vector.

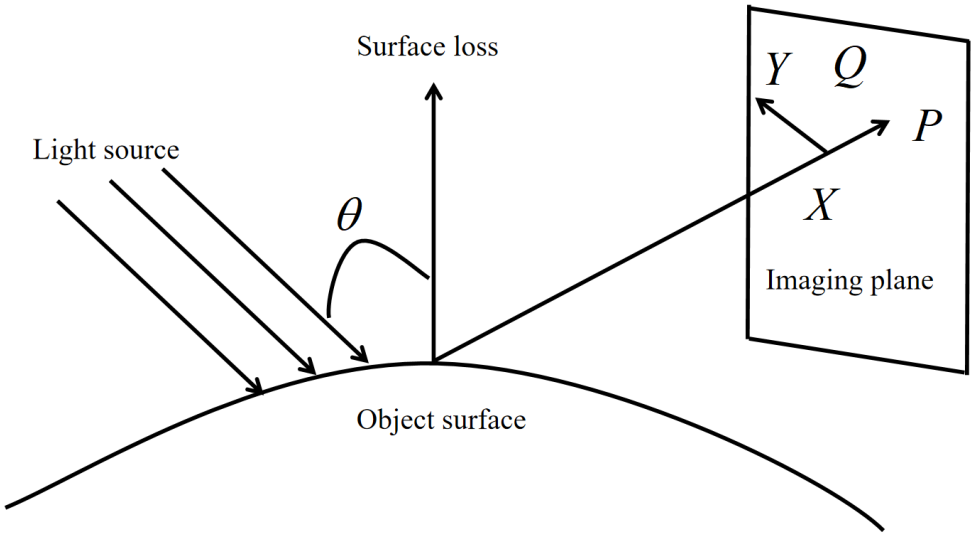

Figure 2. SFS schematic diagram

The description formula for the intensity of a light source at a certain point in an object is $I(x,y)$, and the vector of the incoming direction of the light source can be described by $(p,q_i,-1)$, and the normal vector of a certain point in the object to be measured is described by $N=(p_s,q_s,-1)$, which is the angle between the normal vector direction of a surface point and the incoming direction of light. For any point in the object to be measured, the reflection capacity value can be expressed by θ, and (p,q) represents the surface point of the object.

$$E(x,y)=R(p,q)=I(x,y)\rho\cos\theta \tag{1}$$

When obtaining an image of an object through a collection device, the brightness will be affected by many external disturbances or factors of the device itself. The purpose of SFS is to obtain the gradient value of each pixel point, which is equivalent to two solutions of the equation. However, under known conditions, only one information of the gray value is available for a certain point. In this case, a deterministic solution can be obtained by adding some constraints.

3.2. Establishment of improved model for inspection system

The inspection of the deformation of flat and small parts based on digital image processing is mainly to check the straightness of parts, and its general process is: image acquisition, image denoising, target image edge extraction, fitting calculation of straightness index, comprehensive use of various evaluation factors to judge whether straightness is qualified or not, and output results. Obviously, there are only two types of discrimination here: qualified and unqualified. Here, I and II are used to represent qualified and unqualified parts respectively. The subdivision method divides the object into regular tetrahedrons by using the grid lines on the surface of the object, and finally sums these tetrahedrons by using statistics, but because of the low efficiency of this method, this method should basically not be used in the application of volume measurement. Estimation method is to estimate the parameters of the object to be measured by using the known volume parameters of the

object; The idea of integration method is to divide the volume of irregular objects into the sum of multiple micro-cylinder volumes by using the principle of integration, and the micro-cylinder volume is the product of the area of irregular cross-section and the height of cylindrical objects.

Random error is the difference between the final value obtained and the average value obtained from several measurements in the same environment. Due to the large size of the captured image, a scaling operation was performed. After scaling, the pixel equivalent value will become larger, so the calculated volume of each pixel block will become larger, which will increase the measurement error of the volume, also known as system error. By improving the algorithm and determining the judging principle, the light band central axis tracking method has a good effect on overcoming the central axis error caused by the edge mutation of the light band. In areas with edge mutations, the eccentric deviation of the central axis point deflection line will have a drastic change that is far greater than 1, and by searching for domain points, changing the deflection line cannot achieve the goal of reducing the eccentric deviation. In this case, the criterion for judging the center axis point by the eccentricity difference should be adjusted in a timely manner, and the absolute value of the difference between the same side of the deviation line of the pilot and base points and the light band point set should be used to determine whether the point belongs to the center axis. During volume calculation, each pixel point of a stone is discretized to obtain the height value of the pixel point. However, each point of an actual irregular object is continuous, resulting in certain volume measurement errors during the discretization calculation process. Moreover, the finer the discretization of pixel points, the more accurate the measured object volume is. The coarser the discretization of pixel points, the greater the volume calculation error obtained.

4. Conclusions

Contour recognition is widely used in the generation of assembly drawings of engineering drawings, and automatic contour recognition is also a key basic work for graphic parameterization. This paper mainly discusses the measurement of image measurement technology in two-dimensional coordinates, and studies the color image analysis, image sharpening and numerical analysis. This paper analyzes the application of image measurement technology in the measurement of workpiece contour shape, and expounds the selection of hardware and the design of algorithm. Through analysis, it is proposed that the key to consistency testing is to measure the value of the shape variable at the relevant position of the coil shifting needle, and then determine the straightness error in a certain direction of the coil shifting needle to characterize the size of the shape variable. Comparing the test results of the system with the results of manual needle picking, the coincidence rate between the two is above 95%, so it has certain accuracy. The binocular camera was calibrated using the manual and stereo calibration toolkits provided by MATLAB. The relative position relationship between the left and right cameras was determined using the parameters obtained from camera calibration, and the stereo correction was performed on the images collected by the camera using the parameters obtained from calibration.

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