Application of Digital Image Processing Technology in Interferometer

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Shuyu Zhou, Geng Zhang, Jia Li
Chongqing Technology and Business Institute, Chongqing City, China

***Abstract*—For the history of the development of digital image processing and the content of the involved. Departure from the point of view of the advantages and development trends of digital image processing technology, and digital image processing technology in the specific application of the interferometer made a certain degree of analysis. In this paper, digital image processing technology in wide range of applications and significance of the interferometer, made some research, expect these research and analysis, for development of digital image processing technology and its further development in the interferometer, to have certain reference and guidance significance.**

***Index Terms*—Digital image processing technology, interferometer, application and analysis, CCD.**

I. INTRODUCTION

On vertical interferometer contact, to take advantage of the CCD (charge-coupled device) to the development of modified visually by observing the change and interpretation for reading, and as a basis for the photoelectric detection, automatic aiming and measurement step, the interference fringe image under the microscope, through the use of CCD acquisition, and then transferred to the computer. 0 interference by the effective combination of digital image processing technology, the wavelength given degree method to automatically set, and the proposed legal basis of bilateral straight line, to 0 automatically determines the correct position of the interference fringes center, a comprehensive gauge block formed stripes based on the length of the gauge block offset pixel value calculation. Experiment results show that: in the field of digital image processing technology in the application fully, for the possibility of the existence of human interpretation errors has carried on the beneficial to eliminate, also is able to improve the working efficiency, and the result is reliable and stable operation.

II. BACKGROUND ANALYSIS

In the context of the rapid development of computer technology, especially the strong development of computer hardware and software technology and the popularity of digital image processing, academic research and engineering applications has become a very important area of research in this sphere. Use of computer or other digital devices, the process and results of various types of processing and handling for all types of image information is an emerging application disciplines - digital image processing. This emerging application disciplines developed very rapidly, and has a very wide range of applications, especially in the field of image processing computer vision technology testing process using high accuracy and good reliability for the degree of automation greatly improved, and the speed and accuracy of detection, and thus has a very practical application value.

III. SYSTEM PRINCIPLE AND ELEMENTS

CCD image sensor, as a main component constituting the system, and to install the CCD image sensor the eyepieces position of the interferometer, and through the lens on the camera image of the object focused onto the CCD chip, and then the intensity of light degree, CCD corresponds to the proportion of cumulative charge. Under the control of a video timing, the charge accumulated in each pixel by the relocation of the point, after an enlarged filtering processing, thereby forming a video signal and outputs. This system mainly consists of three parts for image getting, analysis and processing images, display and output images. For the application of image processing technology, the general is the length of the interferometer and measuring the amount of block length two aspects.

A. Principle for Scale Value of Eyepiece

Determine the eyepiece reticle the scale value of the scale, is the set of interferometer. When close to use the length of the standard quantity generally through the filter, and through the center of the light wavelength calibration value. Analyzed from the working principle of the interferometer, the spatial length of a number of interference fringes to be represented, this can be expressed as in (1)

$$\Delta L = m \bullet \frac{\lambda}{2} \quad . \tag{1}$$

the interference fringes is the amount of movement generally expressed in m.λ ,that divided by 2 , represent the wavelength of light waves. As in certain fringe spacing, also contains certain scale ruler, the ruler scale values can be expressed as in (2).

$$i = \frac{\Delta L}{n} = \frac{m\lambda}{2n} \quad . \tag{2}$$

B. Measurement Principle

Millisecond comparative measurement method is a general common practical method of measuring the amount of block length. With higher gage block of known size label quantity to be measured as the difference of blocks and standard gauge block measurement,so the measured length of the block can be expressed as:

L1=L2+ΔL, , where L2 standard The center length of the gauge block, and generally used for the numerical test.

IV. GENERAL SITUATION OF IMAGE PROCESSING SYSTEM

Factors affected by the optical lens and the noise can also affect the collection to the interference fringe image accuracy. Transmitted from the image data, and then according to target system for analysis and processing, so the feature extracting is convenient, is the main purpose of image processing. Obtain accurate clear interference fringes, also is the ultimate goal of this system. As for the specific image processing process,generally as shown in below ways.

A. Overview of the Way of Image Processing

Through CCD image, first on one side for the main window shows the current position of the sensors to obtain image content, at the same time, image storage arrays of Pointers and the return of the image information such as the high and width, properly handle the process of true color image into grayscale, so as to reduce the storage space, and then to accelerate and enhance for the image processing speed. After this, according to the information returned calculate three components corresponding to each column of pixels are summed and the sum of all and for the three components of the program. Extracted to a value of this feature, the relative height of the corresponding straight line in the dialog shown, is thus obtained after the image processing is the result value.

The figure 2 and figure 3 is the original image and processed image respectively, which is a graphic image processing visual processing.

B. Analysis on Image Processing Technology

Original image pixels per column of R, G, B component waveform diagram and the accumulated value, is the result in figure after image processing. The darker of this color represented, the smaller of the sub-magnitude pixels of R, G, B. To determine the black strip center, it is necessary through the waveform chart to find minimum value to be determined. In CMOS devices, however, the uneven photosensitive pixels corresponding, the vast majority of cases, random fluctuations of the image intensity distribution center distance and stripe centre is not photosensitive element integer times series and so on many factors. So minimum value can only be effectively marked the approximate location of the center of the black stripes, without further profound meaning.

The randomness generated when measuring the extremum points is a great characteristic. To eliminate the drawback of a single extreme point of the relatively large random and shielding required to obtain a more precise zero order black stripe center more precise location value, but also make use of the minimum and data nearby.

Usually by bilateral straight-line fitting, curve fitting and gray-level integral method, the fitting method of the three commonly used to implement. In this method, due to having a high degree of accuracy, and therefore it is easy to implement, so the design method is used herein bilateral straight fitting. In this manner, by select for both upper and lower threshold levels of the grayscale, respectively, in the above the crest gradation curve cut out both the right and left of the curve segment, respectively in these

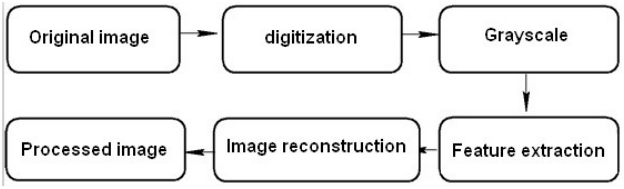

Figure 1. This is a complete process analysis of image processing system

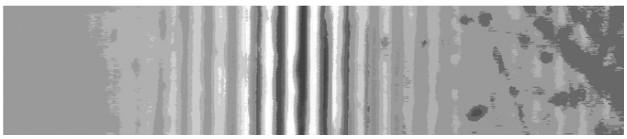

Figure 2. The original image

Figure 3. The image after processing

two curve segments fitting a straight line generated by the selected two upper and lower gray threshold line and a straight line obtained by fitting a respective one point of intersection, then the midpoint of the two points of intersection and the other side of the midpoint of the two points of intersection, the center of the line segment connected to the position and determine fitting results 1, and as a measurement of geometric center. Next, through to find out and abscissa waveform curve at its lowest level as the center, around toward two directions respectively to two peak search on both sides, for the value and peak valley around 3-5 points effectively to remove, so that you can use the rest of the range for curve fitting. Through the rest of the interval points and the use of the smallest squares method, respectively for the straight line on both sides of the fitting. Upon completion of fitting, the intersection of two straight lines obtained by fitting the results 2, that is, the value of the black stripe center here.

Using this method, a single point cannot be determined to the center of the stripe, stripe near the extreme points of a series of points, can be determined, so that it is just right for the random fluctuations of a single pixel, and thus affect the measurement results of the phenomenon elimination, and also for CCD pixel segments played a promotion and realization of the role.

Through bilateral linear fitting for each stripe trough can automatically fitting and effective identification, order number for each trough, and the number selected by the two stripes to the corresponding text box to enter, for the spacing between the stripes fringe number and spacing of the number of pixels, the software can automatically calculated, and the corresponding standard values provided by the instrument, that is, 1 stripe corresponding to a value of 0.283 is thus for each of the pixels corresponding to the length of the value, this can expressed as in (3).

$$K = \frac{0.283 \times m}{n} (\mu m). \tag{3}$$

In this paper above, some of these digital image processing technology in some applications of the interferometer made some analysis, at the same time, think it is necessary to do some research on digital image processing technologies and applications, so for us a comprehensive understanding of digital image processing technology, and other fields of application, can play a better role.

V. DEVELOPMENT HISTORY OF DIGITAL IMAGE PROCESSING

The image signal is converted to a digital signal, and using a computer in order to complete its processing, which is digital image processing. In the 1920s, image processing application for the first time, to the 1960s, along with the extensive application of computer image processing technology and therefore constantly improve and become an emerging discipline. With the continuous development of the technology, computer technology, thinking, scientific research and artificial intelligence in this regard also continue to develop and mature, how to use a computer system to explain the image in order to achieve the understanding of the wider world of the human visual system, this personas computer vision, or image understanding techniques, through the use of digital image processing, so as to achieve the graphic modifications and improvement of image quality, especially effectively extracted from the image compression information, and the image volume, thereby facilitating the processing of digital image transmission and preservation. As for the non-linear processing is easier to achieve the processing program and parameters having a variable, so the digital image processing, image processing technology is a high precision and versatility, the method is very flexible and able to handle and to save the information and transmission are very reliable , has been related personnel generally welcomed.

VI. SPECIFIC APPLICATIONS OF DIGITAL IMAGE PROCESSING

Digital image processing technology major areas of research and application areas is reflected in the following aspects:

A. Image Compression Coding

Image compression encoding technology, a large number of degrees of reduction in the amount of data for the image processing time, the image transfer process corresponding to the saving and the memory capacity is also reduced. Without distortion, compression can be easily obtained, appropriate extent permitted by distortion. Compression technology is the most important method is encoding, it is the first image processing technology is the most mature technology categories.

B. Image Transformation

Because of having a very large image array, if the direct treatment space domain there will be a great amount relates. Various types of image change and approaches for various types of conversion the corresponding indirect, so that we can deal with spatial domain conversion to handle the transform domain, this approach will not only reduce the amount of calculation, and also more effective treatment . Current and emerging research wavelet transform in the frequency domain and time domain, has a good localization characteristics. Therefore, in image processing, which it will have significantly more effective and widespread applications.

C. Image Enhancement and Recovery

In order to improve the image quality, it is necessary for image enhancement and recovery. For instance, the improvement of the image sharpness, noise removal, and so on. The reason for image degradation is not considered, and thereby revealed prominent, such as strengthening the high-frequency component of the image, so that the details of the obvious and clear contour of the object image for the portion of interest in the image thereon, which is for image enhancement .As for the degraded reasons of image restoration, requires a degree of understanding of the image, and the corresponding degradation model is established according to the process of degradation, then filtering method for the original image restoration or reconstruction.

D. Image Classification and Identification

In which the classification and recognition process is carried out for the image, because all belong to the scope of pattern recognition, so this process is generally by a certain pretreatment, such as compression, enhancement and restoration, for the image, the corresponding partition, and wherein the appropriate extraction, thus classify its judgment. Classification image, in general, the classic pattern recognition, syntactic structure model and statistical pattern classification is commonly used way of two segment. In recent years, the newly developed artificial neural network model classification and fuzzy pattern recognition, image recognition process, the enormous role by increasing the level of attention of the people

E. Image Description

Describe the image for image understanding and recognition is the basic and necessary precondition. In the binary image is very simple, can through the geometric characteristics for the specific features of the object description, generally uses the two-dimensional image shape description method, and describe and boundary described two ways.The two-dimensional texture features, which are generally special texture image. Along with in-depth development of image processing research techniques for the study of three-dimensional objects described already underway, this description with generalized cylinder surface description and describe the three types of specific description of the volume.

F. Image Segmentation

Digital image processing, image segmentation is one of the key technologies. The image meaningful comparison characterizing part to be extracted and refined, thereby meaningful representation of the characteristics of their region or the edge portion of the image, this is for the segmentation of the image, but also for a further understanding of the image analysis and recognition on the basis of and an important part. Currently research and analysis of regional segmentation and edge detection methods, although many, but is not a method is generally applicable for all kinds of images can be. Based on this, for the image segmentation research continues to deepen, and this is the current research in key areas and hot spots of image processing.

VII. APPLICATIONS OF DIGITAL IMAGE PROCESSING

In general, the field of application of digital image processing technology is very extensive, common are: the application of aviation and aerospace technology; application in biological and medical engineering field; Applied in the field of communication engineering; the application of engineering and industry; in the field of public security and military applications; Application in the field of culture and art.

This paper mainly for digital image processing technology in the interferometer is analyzed. The application of this belongs to the typical application in biomedical field.

Due to a wide range of applications, and create a huge amount of social value, but is also unable to meet many of the needs of the community. so it needs us to this technology unceasing exploration, development and improvement, from the perspective of more in-depth and more perfect, based on optimization algorithm and a faster processing speed, thus smart generated, processing, recognition and understanding Graph.

VIII. CONCLUSION

In this paper for the application of digital image processing technology in interferometer operation process, to the back of the relative measurement,we must get the difference of the standard gauge block and test block gauge, so a fully identify and operation for the final value and formula can been done.

Test standard gauge block to select a certain standard for calibration block detection. Before the start of the test, it is necessary to first make the appropriate adjustments for the touch interferometer ships mainly from the interference stripes and light source to be adjusted, dividing the value of the instrument also need to be suitably adjusted so that the measured data can reaction test results.

In this series of tests and the calculation process, especially through the use of various algorithms, image processing techniques for image by digital processing, basic and sufficient to achieve the automatic data collection and automatic processing data of these purposes, and also can carry on the automatic calculation and effective for the record, and for the possibility of artificial interpretation errors effectively avoid or eliminate, for there may be a system error in the measurement process and the larger the probability of error occurred, and the corresponding to reduce and avoid moderately, it greatly improve the measuring precision of the system.

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Authors

Shuyu Zhou is with the Chongqing Technology and Business Institute, Chongqing, CO 400052, China (e-mail: qydbzzw@sina.com).

Geng Zhang is with the Chongqing Technology and Business Institute, Chongqing, CO 400052, China (e-mail: qydbzzw@sina.com).

Jia Li is with the Chongqing Technology and Business Institute, Chongqing, CO 400052, China (e-mail: qydbzzw@sina.com).

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