Damage Identification Method of Building Structure Based on Computer Vision

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Abstract. Under the influence of load, earthquake, settlement and other factors, the building structure will be damaged to different degrees. If the building structure damage is not found and handled in time, it will lead to the risk of building components falling off or even collapsing. Therefore, a method of building structure damage identification based on computer vision is proposed. According to different damage types and mechanisms of building structures, the identification criteria of building structure damage are set up to provide reference for damage identification. The computer vision technology is used to collect the building structure image, and through geometric registration, light correction, graying, noise reduction and other steps, complete the preprocessing of the initial building structure image, improve the image denoising effect, and avoid the impact of noise, light and other factors on the recognition results. The image features of the building structure are extracted from the three aspects of color, texture and geometric shape, and compared with the set recognition standards. The damage type of the building structure is determined by similarity measurement, and the identification results including the damage parameters of the building structure are output. Compared with the traditional identification methods, the identification accuracy of the optimized design building damage identification method is improved, and the parameter identification error is smaller, that is, the identification performance is better.

Keywords: Computer Vision · Building Structure · Structural Damage · Damage Identification

1 Introduction

Construction refers to the artificially constructed assets, which belong to the category of fixed assets, including two categories of houses and structures. A house refers to an engineering building for people to live, work, study, produce, operate, entertain, store and carry out other social activities. Different from buildings are structures, which refer to engineering buildings other than houses, such as walls, roads, dams, wells, tunnels, water towers, bridges and chimneys [1]. In house construction, the system composed of various components that can withstand various functions is the building structure. Under

B. Wang et al. (Eds.): ICMTEL 2023, LNICST 533, pp. 183–199, 2024.
https://doi.org/10.1007/978-3-031-50574-4_13

the influence of factors such as load, earthquake, temperature change, and foundation settlement, building structures will be damaged to varying degrees. If the damage to the building structure is not detected and dealt with in a timely manner, it will lead to the danger of building parts falling off or even collapse. The safety of building use, a method for identifying damage to building structures is proposed.

At present, the structural damage identification mainly uses the monitoring acceleration, based on the dynamic inversion theory to identify the structural damage and modify the mechanical model. Since structural modal parameters are functions of structural physical parameters and boundary conditions, and are only related to the characteristics of the structure itself, structural damage identification methods based on modal parameters have been widely studied. In addition, it also includes such methods as mode confidence criterion method, curvature mode method, stiffness method, flexibility method, residual force vector method, modal strain energy method, etc. However, a large number of studies have shown that the natural frequency of structures is often greatly affected by environmental effects, such as the change of natural frequency caused by temperature is even greater than that caused by structural damage; In addition, a parameter such as frequency, which reflects the overall performance of the structure, may not be sensitive to early minor local damage. Therefore, such methods have been difficult to be applied in practice, which has become an important bottleneck restricting the application of structural health diagnosis theory in civil engineering.

Aiming at the problem of low recognition accuracy of existing methods, this paper proposes a method of building structure damage identification based on computer vision. Computer vision technology can transform the identification of building structure damage into image recognition, and use computers to process, analyze and understand the image to identify various targets and objects with different patterns. It can reduce the difficulty of building structure damage identification, and also improve the identification performance of building structure damage. At the same time, the method in this paper completes the preprocessing of the initial building structure image through geometric registration, light correction, graying, noise reduction and other steps, which improves the image processing effect, and is conducive to improving the recognition effect.

2 Design of Damage Identification Methods for Building Structures

2.1 Setting Building Structural Damage Identification Standards

The damage of building structures includes cracks and deformation. Among them, cracks are the most common damage of building structures. At the initial stage of cracks, they have little impact on bridge operation and road driving, and almost no impact. If timely maintenance and remedy are not taken at the initial stage of crack formation, the damaged cracks will gradually form deeper cracks over time, which will affect the stability of the overall structure and pose a threat to the safety of vehicles and pedestrians [2]. Therefore, relevant departments need to take effective detection and maintenance programs, and take measures to ensure safety in the period when cracks have not deteriorated. The cracks can be divided into four categories according to their shapes and trends. The specific damage types and characteristics of building structures are shown in Table 1.

Table 1. Description of the types of cracking damage in building structures

Damage type number	Types of structural cracking damage	Cracking damage characteristics
1	Lateral cracks	The cracks are parallel to the ground, mainly distributed in the bottom interlayer, bottom plate and roof, etc. Such cracks are divided into road surface temperature shrinkage cracks and base layer reflection cracks. Normally, most of the cracks are equally spaced
2	Longitudinal cracks	Such cracks are perpendicular to the ground and are mainly distributed at both ends and corners of the building
3	Block crack	The staggered distribution of transverse cracks and longitudinal cracks makes the pavement split into many large blocks, and the blocks are also interlaced with each other
4	Mesh cracks	This type of fracture is a regional block formed by multiple fractures with different strikes, generally showing an irregular grid shape of smaller blocks

The reason why the cracks and damages of building structures can be identified through images is that the cracks are quite different from their backgrounds. Using computer technology to recognize and classify cracks, the quality of the recognition results largely depends on the selection and extraction of fracture feature vectors. Through the analysis of the crack characteristics of the building structure, the building structure with cracking damage can be summarized as: compared with the image background of the building, the crack performance will be obviously darker, that is, the pixel gray value of the target area is lower than that of the background pixel; There are obvious edge contours in the image performance, that is, the gray value of the area around the crack is small, and the gray value of the background is large, resulting in a very large difference in gray level between the background and the pixels adjacent to the crack; the overall performance of the crack is in the image. Although there may be fractures at local locations, discontinuities are allowed within them; building structural cracks are linear targets with different lengths and widths, and their trends are also different [3]. According to the above method, the characteristics of the image corresponding to the deformation and damage of the building structure can be obtained, and the summarized characteristics can be stored in the form of quantitative feature variables, which can be used as the identification standard of the damage of the building structure.

2.2 Using Computer Vision to Collect Building Structure Images

With the support of cameras and light sources, the building structure images are collected according to the process shown in Fig. 1.

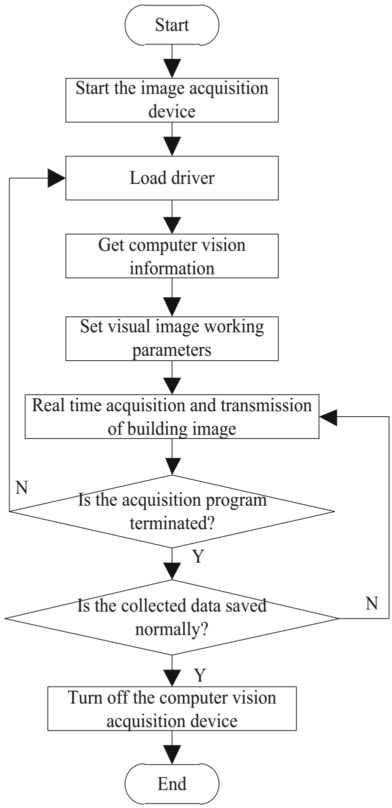

Fig. 1. Flowchart of computer vision acquisition

The process of camera imaging is to convert the 3D scene into a 2D scene and lose the depth information. Therefore, before obtaining the 3D scene information, it is necessary to determine the corresponding relationship between the 3D information and the 2D information, which is determined by the camera model. The process of solving the model parameters is to calibrate each camera [4]. In the measurement process based on computer vision, camera calibration is an indispensable part. The process of camera calibration is to obtain the parameters of each camera model, including internal parameters, external parameters and distortion parameters: the internal parameters are some imaging parameter information of the camera itself, which determines the projection relationship from 3D space to 2D image; External parameters refer to the orientation of the camera in the natural scene, which determines the relative position relationship between the camera coordinate system and the world coordinate system; The distortion parameter occurs in the process of transformation from camera coordinate system to image physical coordinate system. Therefore, the quality of camera calibration results directly affects the accuracy of image measurement of building structures. In machine vision, the projection relationship between the three-dimensional space and the two-dimensional image can be described by the camera model. In fact, there are mainly linear models and nonlinear models to express the correspondence of camera models through mathematical models. The linear model is also called the pinhole model, which means that the object is projected onto the imaging plane through the center point of the optical axis of the camera. However, many cameras are composed of lenses or lenses. Although the lens can collect more light and make the image clearer, it will distort the image [5]. If the measurement accuracy requirements are not so high, the pinhole model can be used for calibration. The calibration principle of the camera is shown in Fig. 2.

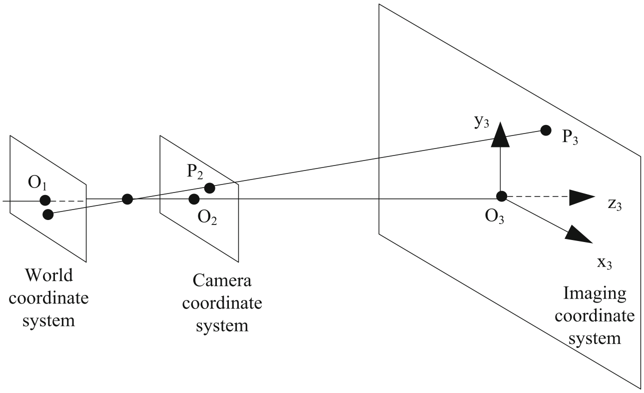

Fig. 2. Schematic diagram of camera calibration

Figure 2 contains three parts: world coordinate system, camera coordinate system and image coordinate system. Assuming $(x_{\text{build}}, y_{\text{build}}, z_{\text{build}})$ is the coordinate of any point in the building structure, the corresponding imaging results can be expressed as:

$$f(x_p, y_p) = \begin{cases} x_p = \dfrac{x_{\text{build}} f}{z_{\text{build}}} \\ y_p = \dfrac{y_{\text{build}} f}{z_{\text{build}}} \end{cases} \tag{1}$$

In formula (1), f represents the focal length of the camera. According to the actual imaging requirements of the building structure, set the working parameters of the camera. According to formula (1), the imaging results of all building structure nodes in the imaging range can be obtained. According to the spatial relationship of the building structure, connect multiple imaging points to obtain the image of the building structure.

2.3 Preprocessing of the Initial Image of the Building Structure

When collecting the image of building structure, the image quality is degraded due to the limitation of actual conditions and the influence of uncontrollable factors such as random noise. At the same time, when analyzing and processing the image, it is required to obtain the image of the target object that is clear, simplified and has eliminated the interference factors. Therefore, the image should be preprocessed before the image detection and analysis.

2.3.1 Image Geometric Registration

The method of image geometric registration is pixel displacement calibration. Pixel displacement calibration is to convert the pixel displacement in the image into the real displacement of the structure, and obtain the corresponding image through the reference object with known actual size in the image and the pixel size of the reference object in the image, so that the integer pixel displacement and sub-pixel displacement calculated in the image are corresponding to the actual displacement through the proportional relationship [6]. The correspondence between the actual displacement and the pixel displacement in the image can be expressed as:

$$w_{\text{actual}} = \frac{J_{\text{actual}}}{J_{\text{image}}} w_{\text{image}} \tag{2}$$

In formula (2), J_{actual} and J_{image} represent the actual size of the building structure and the pixel size in the image respectively, w_{actual} and w_{image} correspond to the actual displacement and pixel displacement. In the actual pixel displacement calibration process, determine the calibration direction of the displacement, and move Δw pixels in the corresponding direction. The calculation formula of Δw is as follows:

$$\Delta w = w_{\text{actual}} - w_{\text{image}} \tag{3}$$

This completes the geometric registration of the initial image.

2.3.2 Image Light Correction

Since the pictures taken by the camera may have unbalanced light, and YCbCr color space is used in the system, it is necessary to compensate for the light. The method used for light compensation is to extract the 5% pixels with the largest brightness in the picture, and then linearly enlarge them to make the average brightness of these pixels reach 255. The brightness of the whole picture is linearly amplified according to the obtained coefficient, specifically, the RGB value of the picture pixel is adjusted.

2.3.3 Grayscale Image

The grayscale image only has the brightness information of the surface of the building structure. After grayscale processing the color image, the processing workload of the computer can be greatly reduced. The color information of the image will not have a great impact on the identification of cracks in the building structure. For the purpose to be realized, it is mainly to obtain the morphological characteristics of cracks, so the identification of cracks in the building structure is based on grayscale images [7]. The grayscale processing process of the initial image can be expressed as:

$$f_{\text{gray}}(x, y) = \omega_R R(x, y) + \omega_G G(x, y) + \omega_B B(x, y) \tag{4}$$

In formula (4), $R(x, y)$, $G(x, y)$ and $B(x, y)$ respectively represent the red, green and blue color components in the initial image, ω_R, ω_G and ω_B correspond to the weight values corresponding to the color components. Thus, the grayscale processing of the building structure image is completed.

2.3.4 Image Noise Reduction

Gaussian filtering is selected as the method of filtering and denoising of building structure images. Gaussian filtering can effectively reduce the degree of blurring effect at the filtering position and obtain better filtering effect. The continuous two-dimensional Gaussian function is discretized to obtain the Gaussian template M, the Gaussian template M is placed at the initial end of the building structure image, and each pixel is filtered through the template, then the filtering result of pixel (i, j) can be expressed as for:

$$f_n(x, y) = \frac{1}{2\pi\delta^2} \exp\left(-\frac{(x - \gamma - 1)^2 + (y - \gamma - 1)^2}{2\delta^2}\right) \tag{5}$$

In formula (5), δ is the weight value of the pixel to be processed in the image, γ is the length of the Gaussian template. The processing results of all the pixel points in the initial image of the building structure are obtained according to the above processing process.

2.3.5 Image Segmentation and Fusion

Threshold segmentation technology is the simplest image segmentation method at present, and its core is to select an appropriate threshold, which is usually selected according to the histogram of the image. The image processed by the threshold segmentation technology is intuitive, easy to implement, fast in calculation, and has a more significant and intuitive segmentation effect for images with different gray levels of the target and the background [8]. The threshold segmentation method is divided into global threshold segmentation and local threshold segmentation. That is, in the segmentation process, each pixel in an image uses the same threshold, which is called global threshold segmentation; If different thresholds are used, it is called local threshold method. The iterative threshold segmentation method is adopted for the segmentation of the building structure image, that is, the segmentation method based on the approximation principle to calculate the optimal threshold value of the image through iterative calculation. This method has strong adaptability and is a more effective segmentation method to calculate the threshold value. Define the initial segmentation threshold as:

$$\eta_0 = \frac{1}{2}(g_{\min} + g_{\max}) \tag{6}$$

In formula (6), $g_{\min}$ and $g_{\max}$ correspond to the maximum and minimum values of the grayscale of the image. According to the threshold set in formula (6), the image is divided into two parts, the background and the target, and the average grayscale of the two parts is obtained, denoted as g_0 and g_b. On this basis, use formula 7 to update the segmentation threshold.

$$\eta_{new} = \frac{1}{2}(g_0 + g_{new}) \tag{7}$$

In the process of building structure image segmentation, the segmentation threshold is updated and iterated in real time, and whether the current threshold is consistent with the target threshold is judged. If the judgment result is consistent, the current threshold is judged as the optimal threshold, and the output result is the optimal solution of image segmentation.

2.4 Extracting Building Structure Image Features

Image features refer to the underlying features of the image itself, mainly including the visual features of the image surface, such as color features, texture features, shape features, and the spatial relationship features of the image content. Color feature is a global feature, which describes the surface color attributes of the scene corresponding to the image or image region; Texture feature refers to the pattern formed by arranging and combining texture primitives according to a certain rule, which is closely related to the spatial transformation of image brightness; The shape feature refers to the contour feature of the image object or the region of interest feature of the image. The contour feature of the image refers to the feature of the outer boundary of the object, while the region feature of the image refers to the feature of the inner region of the outer boundary of the object; Spatial relationship feature refers to the independent segmentation of multiple target objects in the image by segmentation algorithm, and the relative spatial position or direction between them is called spatial relationship feature [9]. The extraction process of building structure image features is shown in Fig. 3.

The color features of building structure images are expressed in the form of color moments. Color moments are a simple and effective color feature. The i pixel in the image takes a certain feature, and the first three color moments are defined as:

$$\begin{cases} A_1 = \frac{1}{N_q}\sum\limits_{i=1}^{N_q} f(q,i) \\ A_2 = \left[\frac{1}{N_q}\sum\limits_{i=1}^{N_q}(f(q,i) - A_1)^2\right]^{1/2} \\ A_3 = \left[\frac{1}{N_q}\sum\limits_{i=1}^{N_q}(f(q,i) - A_1)^3\right]^{1/3} \end{cases} \tag{8}$$

In formula (8), $f(q,i)$ is the i node of image q, N_q is the number of pixels contained in the image, and the solution results A_1, A_2 and A_3 are the first moment, the second moment and the third moment respectively. In the extracted color features of the building structure image, the first order moment represents the average intensity of each color component, the second order moment reflects the color variance of the area to be measured, that is, the non-uniformity, and the third order moment defines the gradient of the color component,

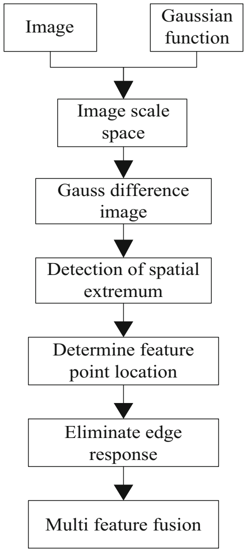

Fig. 3. Flow chart of feature extraction of building structure image

that is, the color asymmetry. Texture feature is one of the important information and features of an image. Texture is usually defined as a local property of an image, which reflects some rules of image gray distribution in a macro sense. Remote sensing images can be regarded as a combination of different texture areas. Various target areas of objects on the image have their own texture features, and these different texture areas are combined to form an image. According to the research on texture features, a variety of different methods for analyzing texture features have been proposed, among which the texture feature based on gray level co-occurrence matrix is the most direct texture analysis method. The gray level co-occurrence matrix method takes the gray value and position of the pixel as the research object, and reflects the comprehensive information of the pixel gray level, such as direction, adjacent interval, and variation range. It is the basis for analyzing the local texture patterns of images and their arrangement. The data of each point in the gray-level co-occurrence matrix represents the probability of occurrence of pixel pairs. Generally, these data are not used directly in texture analysis. We usually use the secondary statistics of the gray-level co-occurrence matrix to define some texture statistics. According to the gray-level co-occurrence, the texture statistics defined by the matrix can be expressed as:

$$\chi = \sum_{x} \sum_{y} (x - y)^2 f(x, y) \tag{9}$$

In formula (9), x and y are the horizontal and vertical components of image pixels. In addition, the extraction results of geometric features of building structures can be expressed as:

$$\begin{cases} \lambda = \frac{4\pi \times S}{L^2} \\ \sigma = \frac{S}{S_{ex}} \end{cases} \tag{10}$$

In formula (10), S is the area of the connected domain of the building texture, S_{ex} is the area of the minimum circumscribed rectangle, and L is the perimeter of the connected domain. The feature extraction results λ and σ represented by formula 10 are the extraction results of circularity and rectangularity geometric features, respectively. Finally, the extracted building structure image features are fused using the fusion principle shown in Fig. 4.

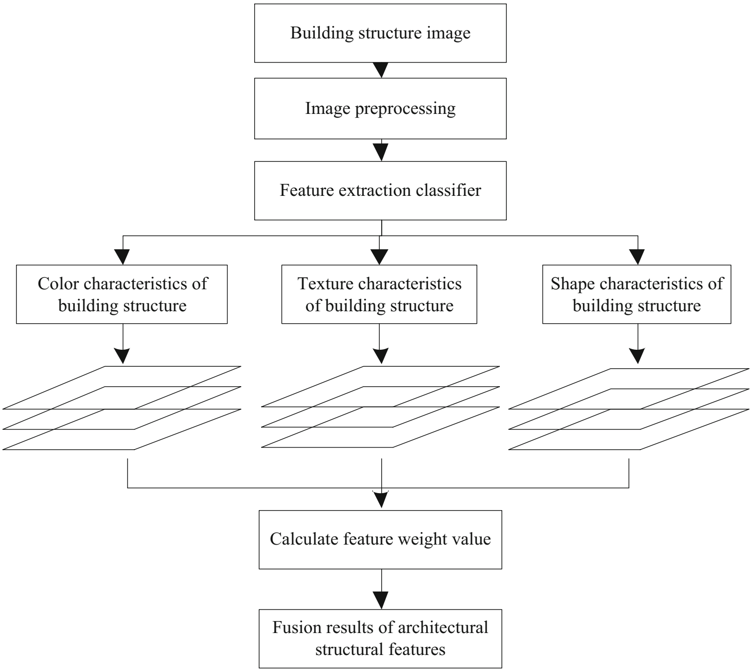

Fig. 4. Principle diagram of image feature fusion of building structure

The final result of building structure image comprehensive feature extraction is obtained, which is recorded as τ_{com}.

2.5 Realizing Damage Identification of Building Structures

The method of similarity measurement is used to match the extracted building structure features with the set damage standard features. Similarity measurement refers to a measure that comprehensively evaluates the degree of similarity between two things. The closer two things are, the more similar they are, and the more distant two things are, the less similar they are [10]. The similarity measure uses the Euclidean distance as the metric, and the Euclidean distance represents the distance between points. When the dimensions of each component of the eigenvector are inconsistent, it is usually necessary to standardize each component first. The measurement method is simple and therefore widely used. The formula for calculating the Euclidean distance between the extracted feature and the set standard feature is:

$$d = \sqrt{\sum (\tau_{com} - \tau_{set})^2} \tag{11}$$

In formula (11), τ_{set} is the set damage standard feature of building structure. After similarity measurement, if the calculated d is higher than the similarity value d_0, it is considered that the building structure corresponding to the current image has damage, and the damage type is consistent with the type of τ_{set}, otherwise it proves that the current building structure has no damage. The damage parameters of building structures with damage are calculated [11–13]. The results of damage parameter identification method for cracked and damaged building structures are as follows:

$$\begin{cases} l_x = (x_e - x_s) \times \varsigma \\ l_y = (y_e - y_s) \times \varsigma \\ S_{\text{damage}} = l_x \times l_y \end{cases} \tag{12}$$

In the formula (12), (x_s, y_s) and (x_e, y_e) represent the position coordinates of the start and end points of the crack in the building structure image respectively, ς is the proportional coefficient between the image coordinate system and the world coordinate system, and the final damage parameter calculation results l_x, l_y and S_{damage} correspond to the damage of the building structure. Length, width and area of cracks. In addition, the parameter calculation results of the deformation and damage of the building structure can be expressed as:

$$\Delta h = \sum_{i=1}^{n} \left| x_{i,\text{actual}} - x_{i,u} \right| + \left| y_{i,\text{actual}} - y_{i,u} \right| \tag{13}$$

In the formula (13), $\left(x_{\text{actual,i}}, y_{\text{actual,i}}\right)$ and $\left(x_{i,u}, y_{i,u}\right)$ represent the current position coordinates and initial position coordinates of node i in the building structure respectively. Finally, the identification results including whether the building structure has damage, damage types and damage parameters will be output in a visual form.

3 Recognition Performance Experimental Analysis

In order to test the recognition performance of the damage identification method of building structure based on computer vision, the experimental performance test experiment is designed by means of comparative test, and through the comparison with the traditional identification method, it reflects the optimal design identification method in the damage management and maintenance of building structure.

3.1 Configuring Computer Vision Equipment

In order to meet the operation requirements of computer vision in the damage identification method of optimized design of building structures, Nikon D7000 camera is selected as the computer vision image acquisition equipment, and the camera's internal parameters such as sensitivity area, resolution, aperture range, focal length, etc. can be determined. Considering the actual environment inside the building, the corresponding auxiliary tools include fill light, tripod, laser rangefinder pen, ruler, etc. Sony ICX625 CCD sensor is used inside the camera, which can enable the camera to obtain high quality, high sensitivity and low noise images. The data interface of the camera is IEEE802.4, which can be directly connected with the main test computer by a network cable, so no image acquisition card conversion is required. The lens used with the camera is COMPUTAR M0814-MP, which features a compact design, less than 1.0% deformation rate, can capture the full resolution of a mega-pixel camera, and has adjustment screws to lock the focal length and aperture, High-contrast, high-definition images are rendered across the entire screen range.

3.2 Prepare Building Structural Damage Identification Samples

All buildings in a certain area are selected as the research objects. Before the experiment, the field survey of the building structure is carried out, the actual data of the building research object is recorded, and compared with the design data of the building, so as to determine whether there is damage to the current building structure and the damage parameters, which are used as the comparison standard to judge the accuracy of the building structure damage identification method based on computer vision. The original image of building structure damage was taken by several inspectors. Using the configured computer vision equipment, it was ensured that the cracks basically appeared in the middle of the image, and no other shooting conditions were set. The resolution of the original image is 1280×1280, the initial acquisition of some building structure image samples is shown in Fig. 5.

According to the above method, all the sample preparation results in the building structure damage identification performance test experiment are obtained, and the number of samples is 8,000.

3.3 Setting the Test Index for Damage Identification Performance of Building Structures

The test was conducted from two aspects: the accuracy of damage type identification and the accuracy of damage parameters. The test index reflecting the accuracy of damage type identification was set as λ. The numerical results are as follows:

$$\lambda = \frac{\mathrm{Num}_{dis-cor}}{\mathrm{Num}_{\mathrm{sample}}} \times 100\% \tag{14}$$

The variables $\mathrm{Num}_{dis-cor}$ and $\mathrm{Num}_{\mathrm{sample}}$ are the number of correctly identified samples output by the identification method and the total number of samples prepared for the experiment, respectively. In addition, the quantitative test indicators of damage parameter accuracy are the identification error of crack length, the identification error of crack width and the identification error of structural deformation. The test results of the above indicators can be expressed as:

(a) Image sample 1 (b) Image sample 2

(c) Image sample 3 (d) Image sample 4

Fig. 5. Schematic diagram of a sample for damage identification of building structures

$$\begin{cases} \Delta\vartheta_x = |l_{x-dis} - l_{x-\text{actual}}| \\ \Delta\vartheta_y = \left|l_{y-dis} - l_{y-\text{actual}}\right| \\ \Delta\vartheta_{\text{deformation}} = |Q_{dis} - Q_{\text{actual}}| \end{cases} \tag{15}$$

In the formula (15), l_{x-dis}, $l_{x-\text{actual}}$, l_{y-dis} and $l_{y-\text{actual}}$ respectively represent the identified and actual values of the length and width of the cracks in the building structure, while Q_{dis} and Q_{actual} correspond to the identified results and actual data of the building structure shape variables. The higher the value of λ, the smaller the value of $\Delta\vartheta_x$, $\Delta\vartheta_y$ and $\Delta\vartheta_{\text{deformation}}$, which indicates that the damage identification performance of the corresponding method is better.

3.4 Identification Performance Experimental Test Process and Result Analysis

The building structure image samples obtained by computer vision technology are input into the running program of the building structure damage identification method, and the corresponding damage identification results are obtained. Figure 6 shows the damage identification results of sample No. 1.

Similarly, the damage identification results of all building structure samples can be obtained. In order to reflect the advantages of the optimization design method in damage identification performance, the traditional damage identification method of building structures based on curvature mode is set as the experimental comparison method, and the identification output results of the comparison method are obtained with the support of relevant data. The output results of the two identification methods are compared with

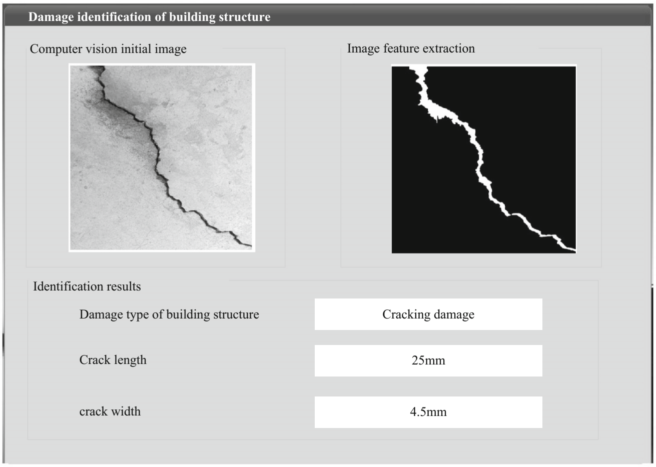

Fig. 6. Damage identification results of building structures

the set damage standards, and the test results reflecting the identification accuracy of building structure damage types are obtained, as shown in Fig. 7.

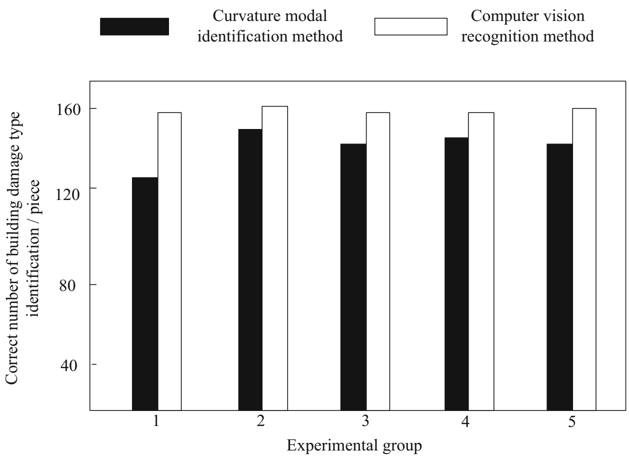

Fig. 7. Test results of building structure damage type identification performance

It can be seen intuitively from Fig. 7 that compared with the traditional identification method, the optimal design method can identify more correct samples. Substitute the data in Fig. 7 into Eq. 14, and calculate the damage type identification of the two methods. The accuracy rates λ are 91.4% and 99.6%, respectively. In addition, the identification results of the damage parameters of the building structure are shown in Table 2.

Table 2. Building structure damage parameter identification data sheet

Sample No	Actual damage data			Output data of traditional damage identification methods for building structures based on curvature mode			Output data of building structure damage identification method based on computer vision		
	Crack length/mm	Crack width/mm	Deformation/mm	Crack length/mm	Crack width/mm	Deformation/mm	Crack length/mm	Crack width/mm	Deformation/mm
1	25	4.5	59	23	4.2	56	25	4.5	59
2	18	3.2	33	15	2.8	31	16	3.0	32
3	26	1.7	76	25	1.3	75	26	1.6	76
4	31	1.4	92	30	1.1	90	30	1.4	91
5	11	3.0	53	10	3.0	51	11	3.0	53
6	16	2.9	45	14	2.6	45	16	2.9	45

Substituting the data in Table 2 into Eq. 15, it is calculated that the average identification errors of the crack length, width and building structure deformation of the traditional identification method are 1.67 mm, 0.28 mm and 1.67 mm respectively, while the average identification error of the optimized design method is 1.67 mm, 0.28 mm and 1.67 mm respectively. The error corresponds to 0.5 mm, 0.05 mm and 0.33 mm. To sum up, compared with the traditional identification methods, the optimally designed computer vision-based damage identification method for building structures has higher damage type identification accuracy and smaller parameter identification errors, that is, better identification performance. This is because the method in this paper completes the preprocessing of the initial building structure image through geometric registration, light correction, graying, noise reduction and other steps, improves the image processing effect, reduces the impact of noise, light and other factors, and thus improves the accuracy of damage identification.

4 Conclusion

Building structure damage identification is one of the important research topics in the inverse mechanics problem. Building structure damage identification is of great significance for extending the service life of buildings. In this context, this paper proposes a method of building structure damage identification based on computer vision. The main innovations of this method are as follows:

(1) Through geometric registration, light correction, graying, noise reduction and other steps, the preliminary processing of the initial building structure image is completed, which improves the image quality and provides a basis for the later damage identification.
(2) Use computer vision technology to collect building structure images, which can reduce the difficulty of building structure damage identification and improve the identification performance of building structure damage.
(3) The experimental results show that the recognition error of this method is low, which verifies its application value.

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