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Retraction

Retracted: Dimensional Defect Detection Research on the Sculpture Surface Combining the Convolutional Neural Network and Gabor

Wireless Communications and Mobile Computing

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

[1] X. Liu, "Dimensional Defect Detection Research on the Sculpture Surface Combining the Convolutional Neural Network and Gabor," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 8259265, 11 pages, 2022.

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Research Article

Dimensional Defect Detection Research on the Sculpture Surface Combining the Convolutional Neural Network and Gabor

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Thematic sculpture creation is an important part of sculpture creation. In particular, the current thematic sculpture creation in China has broken the shackles of serving politics and has shown a variety of aspects such as theme selection, modelling method, material language, and creative purpose. Since the new century, Chinese thematic sculptors have made in-depth analysis and research on the diversity of creative objects, the infinite possibilities of creative expression, and the diversity of creative purposes, especially through the phenomenon of different thematic sculptures to explore their existing predicaments, and give them reflection. If the time is too long, it will reduce the production efficiency of the sculpture production line and increase the operating cost of the enterprise. The Gabor wavelet transform is used to obtain the texture features of the sculpture surface, and the generated high-dimensional features are subjected to random projection dimension reduction. Finally, the binarization algorithm can be used to detect the defect location quickly and accurately. The feature map is extracted by selecting a deep network. The neural network algorithm structure for the sculpture dataset is presented, and the activation function and regularization method are improved on this basis.

1. Introduction

Convolutional neural networks (CNN) are a kind of feedforward neural networks with deep structure, which includes convolution computation. It is one of the representative algorithms of deep learning. Thematic sculpture creation is an important part of artistic creation. At present, thematic sculpture is the most common and widely used form of artistic creation in our real life and is closely related to our daily life. Before and after the founding of New China, affected by the special political environment, China mainly focused on commemorative red revolutionary theme sculptures and heroic portrait sculptures. Hard Times, "Liu Hulan," and other works are of great value to our study of the social and cultural development at that time. The specific creation of these works follows the Western realistic modelling techniques and is created by integrating Chinese local cultural concepts, but there are also characteristics of single creation form and obvious stylized phenomenon [1].

A convolutional neural network has the ability of representation learning and can carry out shift invariant classification of input information according to its hierarchical structure. Therefore, it is also known as "shift invariant artificial neural networks (Sian)." With the reform and opening up, under the background of world economic globalization and cultural diversification, Chinese contemporary sculpture has entered the international stage. Some sculptors have created a large number of sculpture works with their own national characteristics and the style of the times and participated in exhibitions on the world art platform. And exchange activities effectively promote the development of sculpture art in China. At present, the development of information technology and the arrival of the image age have brought a huge impact on traditional sculpture modelling methods. A large number of electronic media and daily-use ready-made products directly or indirectly participate in the creation of sculpture art, extending the language of sculpture modelling and the way to express. Like the development of any other artistic creation, the thematic sculpture creation is inseparable from the influence of the culture of the era. Each era has its own unique culture of the era that affects the creation of artists. In this context, the current

thematic sculptures in China show a diversified creative phenomenon, which contributes greatly to the prosperity of China's new era culture and better participation in world art exchanges [2].

Since the beginning of the new century, with the deepening of reform and the continuous development of cultural undertakings in China, the Chinese Artists Association has hosted a large number of themed art creations and exhibitions and large-scale themed sculpture projects. Strength is important. The National Major Historical Art Creation Project in 2005, Chinese Civilization History Art Creation Project in 2012, the Chinese Communist Party, and the Great Rejuvenation of the Chinese Nation-National Major Art Creation Project and Chinese Homeland Thematic creations such as Art Creation Project in 2017 are the embodiment of the national cultural strategy and are of great significance for promoting the spirit of the Chinese nation and showing the style of the times. In addition, there are also thematic sculpture creation and exhibition activities for major livelihood issues such as the Wenchuan earthquake, the Chinese Dream, poverty alleviation, flood relief and disaster relief, and the ongoing fight against the new crown pneumonia epidemic. The convolution neural network is constructed by imitating the visual perception mechanism of biology, which can carry out supervised learning and unsupervised learning. The parameter sharing of convolution kernel in its hidden layer and the sparseness of interlayer connections enable the convolution neural network to learn grid-like topology features, such as pixels and audio, with less computation. It has a stable effect and has no additional feature engineering requirements for data.

At present, China's thematic sculpture creation is flourishing and developing, and it plays an important role in enriching China's culture and art. However, at present, the problem of surface size defects is common in Chinese sculptures, which seriously hinders the development of Chinese sculptures and causes great trouble to the sculpture industry. Therefore, it is of great significance to detect the defects of sculpture surface size [3].

2. State of the Art

2.1. The Semantics of Urban Sculpture. Urban sculptures are sculptures in squares, parks, roads, and other outdoor environments within the scope of urban planning. It is usually a three-dimensional expression art presented in front of the public by using certain construction materials and selecting appropriate production techniques. The core of the sculpture language is the creation of three-dimensional space. Outside the country, urban sculpture is called public art. The input layer of the convolutional neural network can process multidimensional data. Generally, the input layer of the one-dimensional convolutional neural network receives one-dimensional or two-dimensional arrays, of which one-dimensional arrays are usually time or spectrum sampling. A two-dimensional array may contain multiple channels. The input layer of the two-dimensional convolutional neural network receives two-dimensional or three-dimensional arrays. The input layer of the three-dimensional convolutional neural network receives four-dimensional arrays. From a certain point of view, urban sculpture is called frozen music, which can beautify the urban landscape and spread the long-standing regional culture of the city. Urban sculpture pays attention to the integration of sculpture, people, and environmental space, and the creation of urban sculpture, urban design, and artistic aesthetics integrate and coexist with each other. Today, urban sculpture has been integrated with installations, high-tech sound, light technology, etc., making the original static expression way become a dynamic way of expression [4].

2.2. Current Situation of Sculpture Research at Home and Abroad

2.2.1. Status Quo of Domestic Sculpture Research. Everything has a beginning and an end, and the same is true for sculpture. Although the full text discusses contemporary urban sculpture, it is necessary to clearly understand the trend and whereabouts of domestic sculpture art, the current situation of urban sculpture art, and the imagery spirit conveyed by traditional Chinese sculpture techniques. What are the influences of the creation and design of urban sculptures? Chinese modern sculpture "landed" in Shanghai in 1901. In 1901, Western statues were placed at the entrance of the Shanghai branch of the Hua-Russian Daosheng Bank on the Bund. This is the earliest form of outdoor urban sculpture in the territory. Chinese urban sculptures were introduced along with Western sculptures. These sculptures lacked the background of Chinese traditional culture, which also led to the collision of Western realistic sculptures and traditional Chinese sculptures with the background of traditional Chinese regional culture [5].

Using a gradient descent algorithm for learning, the input characteristics of the convolutional neural network need to be standardized. The standardization of input features is conducive to improving the learning efficiency and performance of convolutional neural networks. In the early 20th century, Western sculpture art entered China following the students who studied abroad, such as Li Tiefu and Liang Zhuting. These overseas scholars opened the curtain for the development of Chinese modern sculpture and the spread of Western sculpture in China. The concept of Western sculpture art began to enter China, and most of the sculpture themes before liberation belonged to the creation of the theme of the Anti-Japanese War. The earliest school where the sculpture major appeared was the Shanghai Academy of Fine Arts. In 1940, according to the instructions of the Ministry of Education at that time, the sculpture major was established. Chinese modern sculpture art absorbed the advantages of Western sculpture and focused on depicting the anatomical structure of human figures. During this period, ancient tomb sculptures and religious sculptures gradually disappeared [6, 7].

Urban sculpture is reproduced in the form of public space art, and urban sculpture begins to pay attention to the close relationship with the urban environment. However, the lack of the integration of cultural symbols in the creation of urban sculptures cannot better reflect the historical and cultural context of the city. The themes of the works are

chosen from the perspective of ordinary people's ordinary occupations, with an approachable style. The main role of urban public sculptures always runs through Shenzhen's ordinary, and the human element is followed by making the public resonate with it. The sculpture theme penetrates into the public and produces an emotional exchange between urban sculpture and the public. Figure 1 is an analysis of the creative thinking of the poet sculpture Cheng Kangzhuang. Contemporary urban sculpture also appears to be integrated with high tech, such as sound and light sculpture controlled by an app and sculpture expression in VR form. In the field of contemporary urban sculpture, sculpture presents a diversified and intersecting development model, and the sculpture art has a trend of "freehand sculpture," as well as the expression form of installation sculpture. The representative figure of "freehand sculpture" is Wu Weishan [8].

Chinese traditional sculpture art reflects the essence of traditional aesthetics and has a certain origin with Taoism. Secondly, Chinese traditional sculpture art and Chinese traditional painting have a very deep relationship. Chinese sculpture emphasizes the imagery spirit of paradox, and the aesthetic essence of Chinese traditional culture is reflected in the sculpture art. The sculpture art in ancient China was not designed in the urban environment, but from the Qin dynasty to the Southern and Northern dynasties and then to the Sui and Tang dynasties, many grotto sculptures and tomb sculptures were created. Their artistic value and conveyed freehand spirit are worthy of future generations.

2.2.2. Current Situation of Foreign Sculpture Research. Looking at the history of Western sculpture, Western sculpture seems to have a fate with the city from the very beginning, and most of it is displayed in the environmental space of the city. Its history can be divided into ancient and modern sculptures. Sculptures in ancient times depicted figures or historical events. Its biggest feature is that it is mainly made of stone materials or metal materials. The parameters in the convolution layer and the full connection layer will be trained with the gradient, so that the classification score calculated by the convolution neural network can be consistent with the label of each image in the training set. Western sculpture has experienced four development periods, the ancient Greek and Roman period, the Italian Renaissance represented by Michelangelo, the French sculpture in the 19th century and the sculpture represented by Rodin, and the Western sculpture in the 20th century [9].

Foreign sculpture art started in ancient Greece and ancient Rome sculpture art. Foreign urban sculpture is deeply influenced by both. In ancient Greek times, sculptures were often attached to buildings for creation, for example, the Parthenon in Athens. The classical period of ancient Greece is a key period for foreign sculptures. Most of the sculptures are based on the theme of human figures, and most of the depiction methods are based on realistic types. Therefore, ancient Greek sculptures conveyed that people are the most glorious elements in the universe for creation. From a certain point of view, Western sculpture presents the style characteristics of perspective and other realism-oriented styles. Just as visible light can be regarded as the superposition of light with different frequencies, through Fourier transform, we can decompose any wave into the superposition of waves with different frequencies. The advantage of this conversion is that in some cases, complex problems in airspace will become very simple in the frequency domain.

In terms of academics, in the book "World Modern Urban Sculpture" edited by Akira Tamura of Japan, it is pointed out that the meaning of sculpture creation should be developed according to the culture of each region, and the sculpture should be suitable for the set regional culture. It illustrates the interconnectedness of urban sculpture and urban regional culture. The book "Urban Sculpture in America" describes the monumental sculptures and garden sculptures in the United States. In the chapter on monumental sculptures, it is proposed that the themes for monumental urban sculptures need to come from historical celebrities in a regional context, who belong to a region or city. While building the sculptures, the surrounding mountain environment is used, and the sculptures are integrated into the mountains for design, similar to the "mountain" sculptures of the Yungang Grottoes in China. It clarifies that the sculptor's sculpture creation should be based on the premise of the overall planning and design, so that the sculpture creation and the surrounding architectural environment should be coordinated [10].

3. Methodology

3.1. Sculpture Multiscale Defect Image Reprocessing Technology

3.1.1. Sculpture Macrodefect Image Removal Technology Based on Median Filtering. Since many noise points are likely to appear in the process of image acquisition by the CCD camera, which brings many disadvantages to the detection of surface defects of sculptures, it is necessary to filter the above generated images. There are many common filtering methods, and here the median filter, which is more commonly used and works well, is used. Median filtering is often used to reduce noise in images and can preserve useful details.

The principle of median filtering is to sort all pixel values in the surrounding field into numerical order and replace the pixel value with the median pixel value in the middle. The calculation formula is

$$y[m, n] = \text{median}\{x[i, j], (i, j) \in w\}, \quad (1)$$

where w is a user-defined neighbourhood centred at (m, n) in the image.

3.1.2. Data Augmentation Technology of the Sculpture Microdefect Image Set. The defect detection method of sculpture images at the microscale is based on machine learning methods. Therefore, in order to train the deep neural network for image recognition to have better performance, such as improving the classification accuracy of the network and reducing overfitting, it needs to use a lot of training data [11].

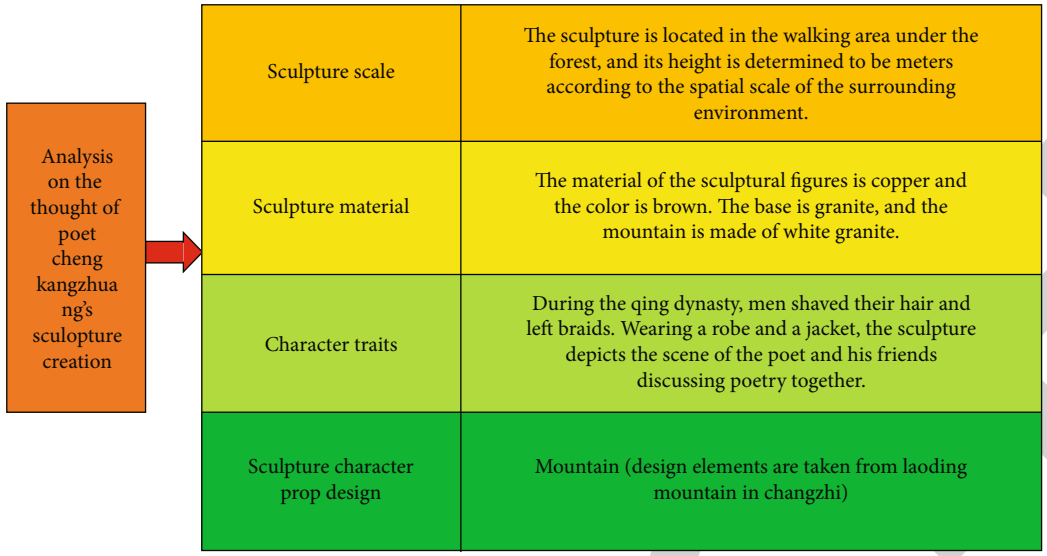

Figure 1: Analysis of the creative thinking of the poet sculpture Cheng Kangzhuang.

In terms of reprocessing, since the pixel values of wafer images usually lie in the range of [0, 255], feeding these values directly into the network may cause numerical overflow and also make some activation functions and objective functions not match these pixel values; for example, in order to stabilize the value of the loss function between [0, 1], these pixel values need to be normalized, and the normalization method uses the mean normalization method. This normalization can remove the average luminance value of the image. Since the training process is not interested in the luminance of the image, the average value can be removed for each pixel here. Its formula is

$$z = \frac{x - u}{\sigma}. \tag{2}$$

Among them, μ and σ are the mean and standard deviation of the dataset, respectively. This method can make the distribution of the original data approximate to the Gaussian distribution, and its distribution curve is shown in Figure 2. The results of mean normalization are shown in Figure 2.

In the process of deep learning, in order to prevent overfitting caused by too few samples or insufficient sample diversity, data enhancement operations such as expansion of the image dataset are performed. Among them, overfitting refers to making the assumptions too strict in order to obtain consistent assumptions, that is, overfitting the training data, resulting in the trained model being inapplicable to new data. Therefore, it is very important to increase the diversity of data and the number of samples, which is beneficial to improve the generalization ability of the model. Here, the image rotation method for the microscopic wafer surface defect image dataset is to randomly specify an angle value instead of specifying a fixed rotation value. The interpolation method here selects the more commonly used bicubic interpolation method. The formula is

$$S(w) = \begin{cases} 1 - 2|w|^2 + |w|^3, & |w| < 1, \\ 4 - 8|w| + 5|w|^2 - |w|^3, & 1 \le |w| < 2, \\ 0, & |w| \ge 2. \end{cases} \tag{3}$$

3.2. Gabor-Based Sculpture Macroscopic Surface Defect Detection Technology

3.2.1. Retinex-Based Sculpture Light Removal Technology. The Gabor feature is a feature that can be used to describe image texture information. The frequency and direction of the Gabor filter are similar to the human visual system, especially suitable for texture representation and discrimination. In many scenes, the influence of lighting has a great impact on the detection of surface defects of sculptures. Reflective parts are sometimes mistaken for defects, and it is particularly important to reduce the impact of light on surface inspection. The retinex theory is used to solve such problems. Retinex is often used to solve lighting and fog image processing [12].

Now common retinex algorithms include single-scale retinex (SSR), multiscale retinex (MSR), and multiscale retinex with color recovery (MSRCR), because a single scale is greatly affected by a single scale, which is not conducive to adjustment. The retinex algorithm with color recovery is mostly used to retain the original color features, and for the detection of grayscale images, the multiscale retinex algorithm is the most suitable. The formula for single-scale retinex is

$$R_{\mathrm{SSR}} = \log I_i(x, y) - \log \left[F(x, y, c) * I_i(x, y)\right]. \tag{4}$$

The multiscale retinex is a weighted sum of multiple single scales, and its formula is

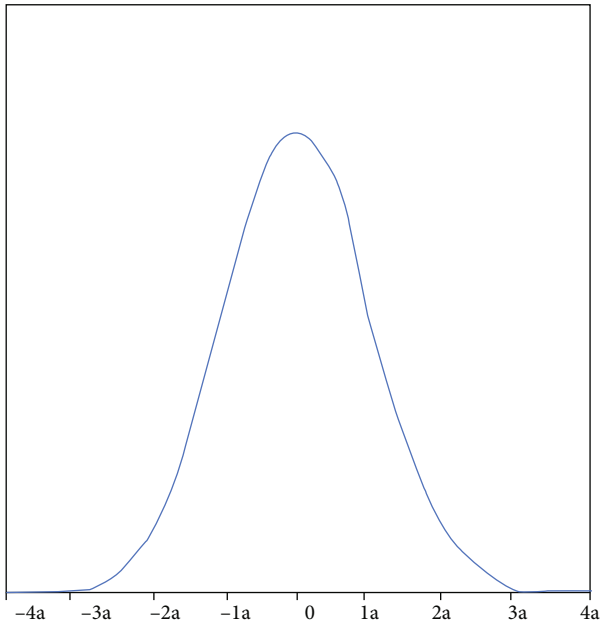

Figure 2: Graph of the distribution of St.

$$R_{\mathrm{MRSi}} = \sum_{n=1}^{N} w_n \{\log I_i(x,y) - \log [F_n(x,y,c) * I_i(x,y)]\}, \tag{5}$$

where N represents the number of Gaussian kernels, w_n represents the weight, and the Gaussian function is

$$F_n(x,y,c) = ke^{\left(x^2+y^2\right)/c^2}. \tag{6}$$

Generally, N is 3, which means that three scales are selected, and the weight is 1/3.

3.2.2. Gabor-Based Sculpture Texture Pattern Feature Extraction. The Gabor filter is a band-pass filter, which is mainly used for texture feature extraction and stereo disparity estimation. The impulse responses of these filters are generated by multiplying a Gaussian envelope function with a complex oscillation. Gabor showed that these minimize uncertainties in time and space, and by extending these functions to two dimensions, selective directional filters can be created. Texture information is usually represented as a pattern repeating arrangement and regular distribution on the image. While in macro on the scale, the patterned sculpture surface has such characteristics, Gabor wavelet can be used to obtain the sculpture surface information, and the corresponding defect position can be detected through these characteristics [13].

2D Gabor can be viewed as a sinusoidal surface at a specific frequency and direction, modulated by a Gaussian envelope. It can be written as

$$h(x,y) = s(x,y)g(x,\mathrm{y}), \tag{7}$$

where $s(x,y)$ is a complex sinusoid called the carrier and $g(x,y)$ is a two-dimensional Gaussian kernel function called the window function [14]. A complex sinusoid is defined as follows:

$$S(x,y) = e^{-j2\pi(u_0x+v_0y)}. \tag{8}$$

The two-dimensional Gaussian kernel function is defined as

$$g(x,y) = \frac{1}{\sqrt{2\pi\sigma}} e^{-(1/2)\left(\left(x^2/\sigma_x^2\right)+\left(y^2/\sigma_y^2\right)\right)}. \tag{9}$$

The Gabor function can also be written as

$$h(x,y) = \frac{1}{\sqrt{2\pi\sigma}} e^{-(1/2)\left(x^2/\left(\sigma_x^2+\left(y^2/\sigma_y^2\right)\right)\right)} e^{-j2\pi(u_0x+v_0y)}. \tag{10}$$

Then, 40 groups of Gabor filters are convolved with the above figure, and the formula is

$$Q(x,y) = \sum_{j=-\infty}^{\infty} \sum_{i=-\infty}^{\infty} p(x,y)H(x-i,y-j). \tag{11}$$

3.2.3. Dimensionality Reduction of Sculpture Image Features and Image Segmentation Technology. Random projection is a tool for representing high-dimensional data in a low-dimensional feature space and is often used for data visualization or methods that rely on fast computation of pairwise distances, such as the nearest neighbor search and nonparametric clustering. In random projection, dimensionality reduction features were compared to traditional feature dimensionality reduction algorithms that discard some eigenvalues, which try to keep approximately the same high-dimensional features. Suppose there is an $A_{n\times d}$ matrix with n data points in the d dimension; then, according to Lindenstrauss' theorem, there is a random matrix $R_{d\times k}$ such that

$$E = AR_{d\times k}, \tag{12}$$

where E is called the projection matrix of d.

With such a random matrix, the function f that accurately maps from the d-dimensional space j to the k -dimensional space E is as follows:

$$f(u) = \frac{1}{\sqrt{k}}(uR). \tag{13}$$

Based on the image segmentation technique of the improved maximum between-class variance method, the threshold segmentation method of the maximum between-class variance method is to iterate all possible thresholds and calculate the propagation rate of the pixels on each side of the threshold, that is, the pixels that fall in the foreground or background. Its purpose is to find the threshold where the sum of foreground and background spreads is minimal [15].

In the maximum between-class variance method, the exhaustive search threshold for the maximum between-class variance is defined as the weighted sum of the two types of variances, and the formula is

$$\sigma_w^2(t) = w_0(t)\sigma_0^2(t) + w_1(t)\sigma_1^2(t). \quad (14)$$

The weights w_0 and w_1 are, respectively, the probability that the pixel falls into the two types of regions with the threshold t. Regarding the improvement of the maximum between-class variance, the more significant method is called the two-dimensional maximum between-class variance method. This method studies the gray value of each pixel and the average value of its neighborhood, which greatly improves the effect of binarization. On each pixel, the average gray value of the neighborhood is calculated. The grayscale of a given picture is divided into L parts, and the average grayscale is also divided into the same L parts. The pixel grayscale and the neighborhood mean are formed as a pair of parameters.

3.3. Faster RCNN Algorithm Based on the ZF Network. Convolutional neural networks can be used in situations where the data can be represented as a map under the premise that the two data points are correlated. An image is such a map, which is why convolution is often heard in the context of image analysis. If you take all the pixels of an image and arrange them randomly, it cannot be recognized, which means the relative position between the pixels is also very important. A convolutional neural network represents an image as a sequence of numbers, applies a series of operations, and finally returns the probability that an object in the image belongs to a particular class of objects. For example, convolutional neural networks can let you know the probability that an image contains a building or a horse. The training time can be reduced to about 8.8 times the original, and the detection accuracy brought by it also meets the requirements [16]. It was proposed that the ROI pooling network layer can map inputs of different sizes to a fixed-scale feature vector. In the regional convolutional neural network, since the sizes of the image candidate regions are not consistent, the resulting feature map size is also Differently, these feature maps cannot be put into a fully connected layer for classification, but ROI pooling is added to extract features of a fixed size for each candidate region and then use the loss function for type identification. The ZfNet structure mainly uses deconvolution technology to understand the convolutional network, adjust the convolutional network, and finally modify the network structure, which greatly improves the classification results. The structure diagram of the Faster RCNN network based on ZFNet is shown in Figure 3.

4. Result Analysis and Discussion

4.1. Analysis of Experimental Results of Gabor-Based Sculpture Macroscopic Surface Size Defect Detection Technology. The experiment uses the i5 processor to process four types of wafer images containing surface defects, which are defined as four types: type I, type II, type II, and type IV. And do a comparative experiment with the traditional template matching algorithm. Figure 4 shows the comparison of the detection accuracy histograms of the two algorithms under different image integrity, that is, the percentage of the sculpture without defects in the entire sculpture area. The detection accuracy is detected by the actual defect area and the two algorithms. The ratio of defects is expressed [17].

It can be seen from Figure 4 that when the ratio of defect to pattern area is smaller, the size of the sculpture defect detected by this algorithm is closer to the actual size, and the effect is the best. When the image integrity is 90%, the detection accuracy can reach 95%, while the detection accuracy of template matching has been maintained around 86%.

4.2. Recognition Method of Surface Size Defects of Sculpture Emblem Image Based on RCNN Analysis. When the gradient of some neurons is always 0, the weights cannot be updated in the process of backpropagation, which will create dead neurons that can never be activated. In order to solve this kind of problem, the algorithm in this paper adopts the improved version of ReLU, Leaky·ReLU. In order to prevent dead neurons from appearing at xs0, the definition function has a small linear component when $x < 0$, and its λ value is a very small value. The main advantage of this replacement is to remove the zero gradient [18–20]. In this case, the gradient on the left is nonzero, so that the weights and biases can be adjusted during backpropagation, and no dead neurons will be generated. The data distribution is shown in Figure 5.

The images collected from the images of sculptures, which contain various defects, also have various types of images. The images are scaled, the size is $224 * 224$, and the four defect types are defined as dust, bump, injury, and blot. In order to prevent overfitting caused by the lack of diversity of samples, the original images are scaled and rotated to obtain about 60,000 sets of data, of which 70% are training sets and 30% are test sets. The next step is to make the dataset into VOC2007 format for Faster RCNN training. The experiments are based on the deep learning framework Caffe, the operating system is Linux, and the version is Ubuntu 16. Due to the large amount of grating, GPU acceleration is used here, and parallel computing is performed on the CUDA 7.5 version.

In order to compare the effectiveness of the algorithm, it is necessary to compare the recognition rate of other algorithms for verification. Here, the traditional feedforward network is selected for detection. Since the ZFNet used in this algorithm extracts deep features, in order to compare the effect of the experiment, the feedforward network is used here. The network also uses ZFNet to train and identify defects. The Faster RCNN algorithm based on AlexNet is also selected, and different deep networks are used to extract feature maps to compare the impact of different deep networks on the detection results. Finally, a more traditional method commonly used in industry—template matching—is selected [21].

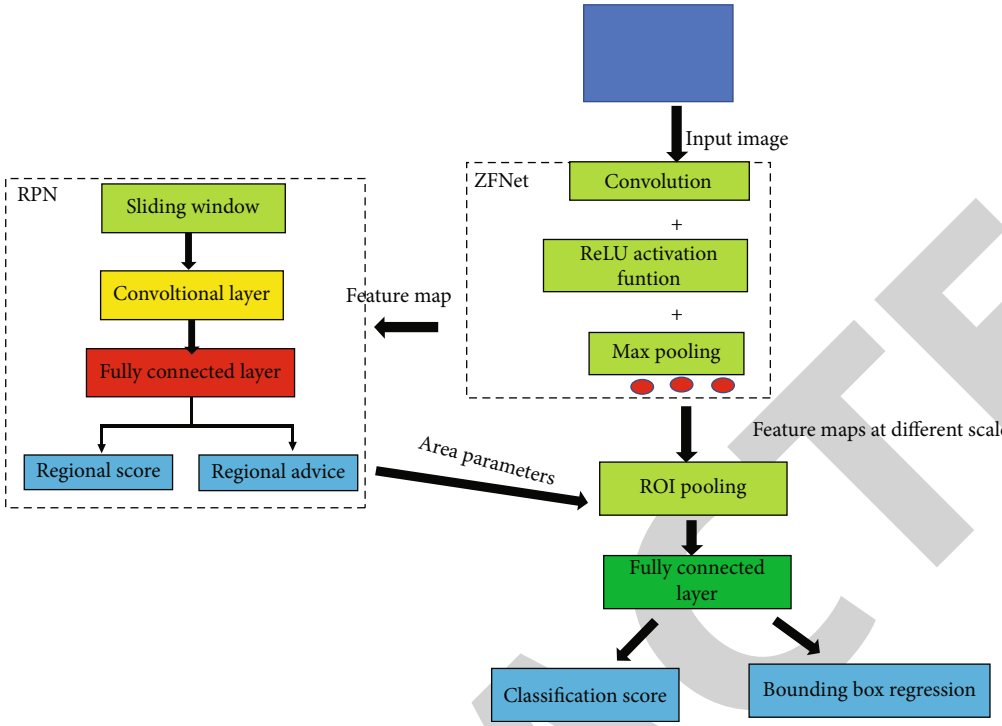

Figure 3: Faster RCNN network structure diagram based on ZFNet.

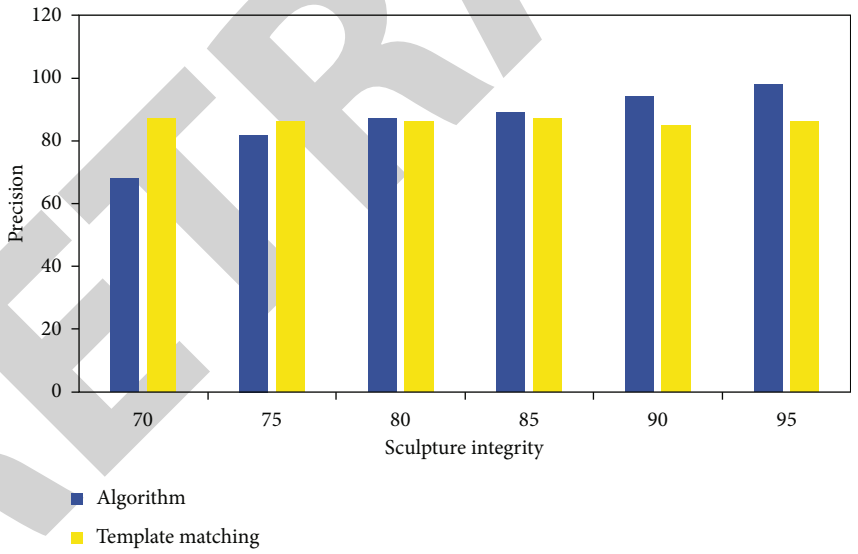

Figure 4: Detection accuracy of two algorithms on different image integrity.

In order to reflect the influence of different sample numbers on the detection accuracy of different algorithms, the curve graphs of the recognition rates of the dust defect under the sample numbers of 10,000, 20,000, 30,000, 40,000, and 50,000 samples are selected here, as shown in Figure 6.

It can be seen that in order to achieve the same training effect, the algorithm in this paper requires fewer samples, and with the increase in the number of samples, the recognition rate of all machine learning-based algorithms tends to be stable. For the template matching method, the recognition rate has been stable at about 86%, indicating that it is not affected by the size of the sample.

In order to evaluate the pros and cons of the model of the algorithm in this paper, the cost function improved by the logistic regression function based on cross entropy is selected for evaluation. The cost function curves of many networks are calculated here, and the cost function curve of the algorithm is shown in Figure 7.

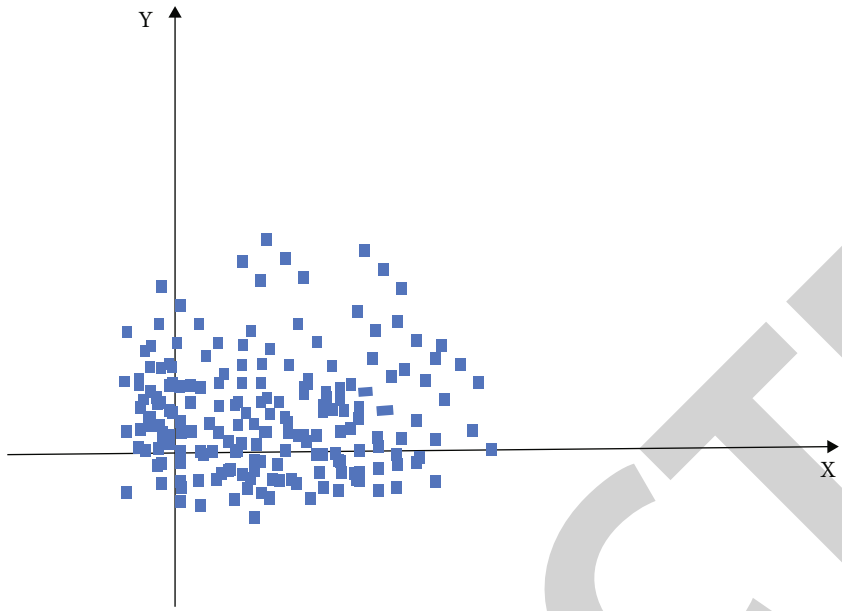

Figure 5: Leaky ReLU data distribution diagram.

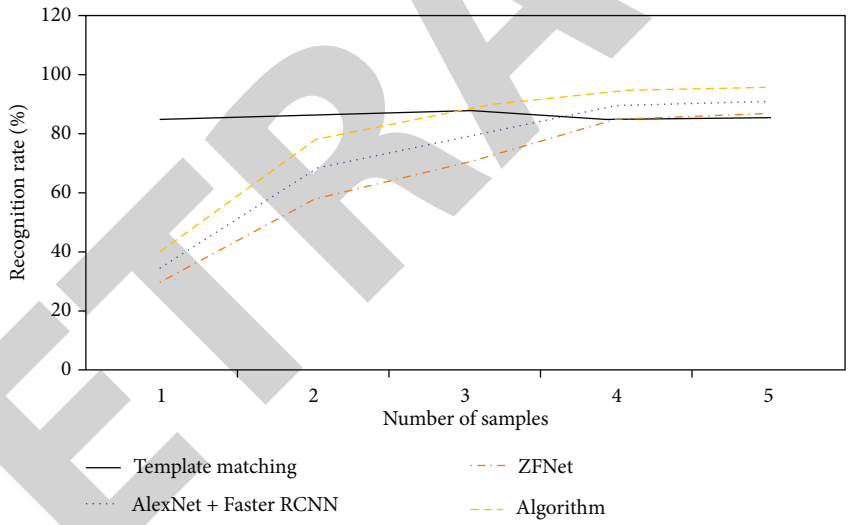

Figure 6: Recognition rate graph of different algorithms.

From the change of the cost function, it is known that the algorithm in this paper has a great improvement in the convergence of the cost function, and the result of the algorithm in this paper iterating 400 times is equivalent to the 600-time iteration of the Faster RCNN algorithm based on AlexNet, which shows that the convergence effect of the algorithm in this paper is better. Gabor features mainly rely on the Gabor kernel to window the signal in the frequency domain, so as to describe the local frequency information of the signal.

In order to better reflect the advantages and disadvantages of the algorithm in this paper, the performance of this algorithm in the detection of microscopic sculpture surface defects is evaluated from four aspects: accuracy rate A, precision rate P, and recall rate R, and average precision rate and recall rate ($F1$). In order to evaluate the pros and cons of the classifier, ROC and AUC are used as evaluation criteria here. When the ROC curve is closer to the upper left corner of the coordinate axis, it can be shown that the classification effect of the algorithm corresponding to the curve is better. The AUC is a probability value, which represents the area covered by the ROC curve. The larger the area, the better the classification effect. Its ROC curve is shown in Figure 8 which shows that when the ROC curve is closer

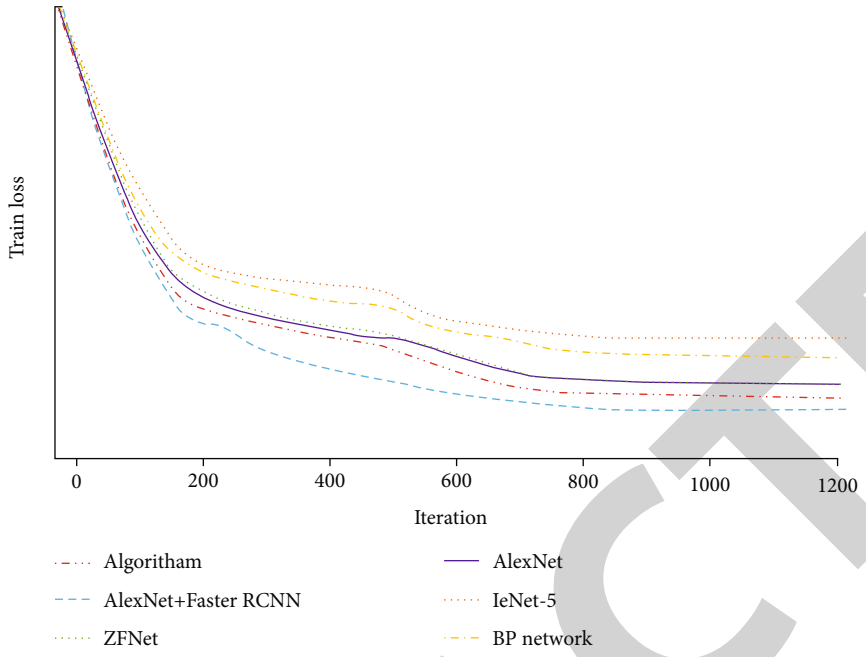

Figure 7: Cost function curves of different algorithms.

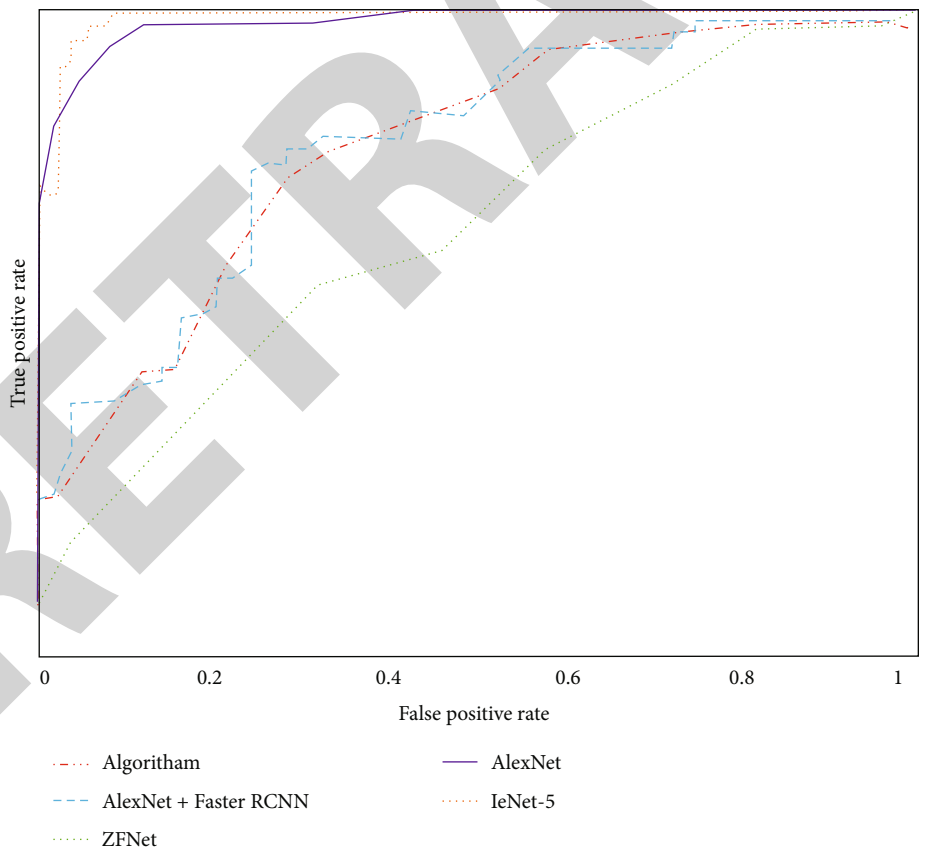

Figure 8: ROC curves of different algorithms.

to the upper left corner, the classification effect of the algorithm is better. It can be seen from the figure that the classification effect of the grating method in this paper is the best [22].

5. Conclusion

A Gabor nuclear energy obtains the response of a frequency neighborhood of the image, and the response result can be regarded as a feature of the image. Then, if we use several Gabor cores with different frequencies to obtain the response of the image in the neighborhood of different frequencies, we can finally form the characteristics of the image in each frequency segment, which can describe the frequency information of the image. The spirit of the place emphasizes "sense of direction" and "sense of identity," while urban sculptures carry the history and culture of the region. The sculptures of historical and cultural celebrities in urban sculptures are the cultural symbols of the region and have the "sense of direction" and "sense of identity" of a common culture. This is in line with the requirements of the spirit of place. The spirit of place does not conflict with the traditional regional culture theory, and they complement each other. The creation of urban sculpture is not the embodiment of the sculptor's personal emotions but the expression of the public's sense of identity. Therefore, artists need to be precise in scale when they are engaged in the creation of urban sculpture. This paper analyzes and summarizes the problem of multiscale surface size defect detection of sculpture based on a regional convolutional neural network. For the detection of sculpture surface defects at the macroscale, an algorithm that uses Gabor wavelets to obtain features and detect defects is proposed, and for the detection of sculpture surface defects at the microscale, a deep learning method is proposed to realize the identification and classification of defects. The improved maximum interclass variance method is used to detect defects at the macroscale. After inspection, the accuracy and speed are improved compared with those of the template matching algorithm. The time is shortened by about 30%, and the accuracy is also improved by about 10%. The algorithm network structure based on ZFNet's Faster RCNN is designed. The final experiment is compared with some existing networks and template matching algorithms. The experimental results show that the recognition rate of the detection of surface defects in sculpture images is high, which can reach 95%. And the convergence effect and classification effect of the algorithm in this paper are very good.

Data Availability

The figures used to support the findings of this study are included in the article.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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