A Paper For Selection

Summary

Here is the abstract of your paper. Image compile continuously develops so that people use images easier. Nevertheless, Outlaws maliciously operates images that become more and more easier. Therefore, it has huge practical significance whether detecting images are tampered. The article does an analysis of whether an image has been changed. By making use of color correlation diagram, eigenvalues could be extracted from images; By making use of Support Vector Machine and classify eigenvalues, a function that judges the authenticity of images, then distinguish the authenticity of images in validation.

For the first problem,The preliminary model :To extract the image of RGB three colors of matrix, using the SLIC super pixels segmentation algorithm, combined with the true and fake of the image, the gray image is transformed into three matrix, generating a 5 * 5 yuan cell matrix, through the matrix to calculate the correlation of matrix and characteristic value, and thus to distinguish true and fake images, according to this algorithm, the accuracy 0.81 towards the defects of the model, the establishment of the second model, the RGB three channels for level 1, 2 d discrete wavelet transform, the original image can be found after filtering matrix than change is clear, then to difference of RG, BG,The filtering operation is then performed.The image is convolved with the sobel operator to get the gradient image.The first 64 images with the maximum variance were used as the index to evaluate the image clarity.For the clarity of R, G,B, RG and BG diagonal low frequency and diagonal high frequency, a total of 5*2=10 parameters are used as evaluation indexes. Finally, support vector machine is used for data training.

For the second problem, the model for solving the first problem was used. After several training, the best function was taken and the image in the validation file was processed to obtain the fake images.

Finally, we consider the advantages and disadvantages of the model comprehensively

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Here is the problem background ...

Two major problems are discussed in this paper, which are:

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- Doing the second thing.

1.2 Literature Review

A literatrue[1] say something about this problem ...

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We do such things ...

1. We do ...
2. We do ...
3. We do ...

2 Preparation of the Models

2.1 Assumptions

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The primary notations used in this paper are listed in **Table 2**.

Table 1: Notations

Symbol	Definition
A	the first one
b	the second one
α	the last one

3 The Models

3.1 Model 1

3.1.1 Detail 1 about Model 1

$$e^{i\theta} = \cos\theta + i\sin\theta. \tag{1}$$

4 Strengths and Weaknesses

4.1 Strengths

- First one ...
- Second one ...

4.2 Weaknesses

- Only one ...

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5 Introduction

5.1 Problem Background

Here is the problem background In recent years, image compile quickly has been developing. But to some extent, Malicious manipulation of images by law-breakers is becoming rampant. Therefore, it is very difficult to detect whether the image is changed or not. Please establish a mathematical model to solve the following problems:

1. The real image is stored in file 1-ture., and the corresponding false data is stored in file 2-fake or 3-fake. Try to select not less than 1000 images from the true and false data and establish the model to detect the true and false images.

2. The image of unknown authenticity is given in the file validation. Try to judge the authenticity of each image according to the established model, and list the name of the fake image (e.g. 00000001.jpeg, 00000003.jpeg) with EXCEL table.

3. Point out the advantages and disadvantages of the models listed.

Two major problems are discussed in this paper, which are:

- Doing the first thing.
- Doing the second thing.

5.2 Literature Review

1. Analysis of problem 1 Problem 1 requires using a large amount of data in the file to establish a model to verify the authenticity of the image through comparison modeling. Since the image is only possible for color tampering, the key to question one is how the image characteristics change after the color contrast changes. The image is composed of red, yellow and blue color components, so the red, green and blue color channel of the image is first extracted. Then it is transformed into three gray image matrices and further processed into three five-order matrices to calculate its eigenvalues. It is found that the real image is generally larger than the false image. By comparing feature values, it can be used to verify the authenticity of the image. In order to improve the accuracy rate, difference images of two colors were obtained by using difference, and then wavelet transformation of $R/G/B/RG/BR/BG$. was performed to obtain the correlation matrix. Diagonal low-frequency component matrix was taken for R/G/B, and diagonal high-frequency component and diagonal low-frequency component were taken for RG/BR/BG, and a total of 9 evaluation indexes were obtained. Then support vector machine (SVM) was used to classify the two thousand samples, and a model was established to test whether the color changed. Then, BP neural network was used to classify the same samples, and the accuracy was further

improved. Finally, a better model to detect the trueness of the image is obtained.

2. Analysis of question 2 Question 2 requires that the name of the false image be listed according to the image obtained in solving the first question. The key of this problem is how to improve the recognition rate of false images as much as possible and reduce the misjudgment rate of real images. First, the model was used to train 1000 data in the documents 1-turn and Fake for many times, and the accuracy rate of the recognition function was obtained. By increasing the number of datum, the corresponding accuracy rate of different training samples was obtained. Finally, when the accuracy rate converges, the number of training samples was stopped to increase. Then we train the fixed data continuously. When the function is relatively optimal, we can distinguish the true and false of the image. The images that were judged to be false were processed with EXCEL.

3. Analysis of question 3 The advantages and disadvantages of the model are mostly the inherent advantages and disadvantages of the algorithm the model is based on. In this paper, the defect of an algorithm is avoided as much as possible through multiple models to better solve the problem.

6 Preparation of the Models

6.1 Assumptions

1.When distinguishing the authenticity of the picture, only consider the authenticity of the picture color, ignoring the effect of image stitching, cropping, adding watermark, enhancing contrast and other aspects on the authenticity of the picture.

2.Ignoring the impact of wavelettransform on edge problems such as image angle arc

6.2 Notations

7 The Models

7.1 Model 1

For the first problem, modeling data to detect true and false images, first of all, the difference between true and false pictures is only the color difference. In this question, the differences in image stitching, cropping, watermarking, contrast enhancement, etc. are ignored. In this case, First convert the image to RGB image with MATLAB Then the problem is reduced to RGB matrix for analyzing true and fake pictures. All the pictures in this question are color maps. The

Table 2: Notations

Symbol	Definition
R	the matrix of the image under the red channel
G	the matrix of the image under the green channel
B	the matrix of the image under the blue channel
ji	picture ji
RG	R to G difference
BG	B to G difference
$mdwt()$	filter function
$nrss()$	sharpness function
$sqrt()$	Square root function
$imfilter()$	Implement linear spatial filter function
$edge()$	Edge detection function

RGB matrix corresponding to the color map is a three-dimensional matrix. However, the three-dimensional matrix cannot complete the quantitative calculation normally. So we convert the RGB image into three gray scale images. When you convert an image into an RGB matrix, the corresponding rows and columns will be generated. When you convert to a grayscale image, you only convert the three-dimensional into two-dimensional. At this time, the rows and columns of the grayscale matrix are still many.Simplify the grayscale matrix and convert it into a 5th-order cellular matrix. Each element in the cell matrix is 100*75, and each element in the cell matrix is summed. At this time, the fifth-order element The cellular matrix is transformed into a fifth-order square matrix. Compared with the true picture gray matrix, the complex correlation coefficient

$$Cov(X,Y) = E[(X - E[X])(Y - E[Y])]$$

$$Cov(X,Y) = E(XY) - E[X]E[Y]$$

and covariance

$$\rho_X Y = \frac{Cov(X,Y)}{\sqrt{D(X)\sqrt{D(Y)}}}$$

of the gray matrix of the fake image is neces sarily relatively small. At this time, the complex correlation coefficient and covariance of the matrix is calculated. Diagonalization processing is performed on the grayscale matrix to obtain a diagonal matrix of the matrix, and then the eigenvalues of the matrix can be obtained, thereby obtaining three specific parameters about the grayscale matrix, and thus only need to be Compare the covariance, correlation and eigenvalues of true and fake images, you can see the difference between true and fake.

7.1.1 Detail 1 about Model 1

It can be clearly seen from the above method that it is difficult to judge the true and fake of the image simply from the eigenvalues and correlations of the matrix, so it is qualitative and quantitative to judge the true and fake of the image.

The three-dimensional image is not easy to process, so the R G B of the image is extracted separately to three two-dimensional matrices to simplify the image. In order to improve the above model, do the following operations on the image. Filtering all three two-dimensional matrices Perform one-level two-dimensional filtering on the three channels of R G B respectively to obtain diagonal low-frequency horizontal high-level vertical high-level diagonal high-level four matrices Total 3*4=12 matrices

$$Y(n) = aX(n) + (1 - \alpha)Y(1 - n)$$

Performing the above filtering operation on the difference image obtained by performing differential pair on RG BG respectively, obtaining $2 * 4 = 8$ matrices

$$RG = R - G$$

$$BG = B - G$$

Convolution of the filtered image with a sobel operator to obtain a gradient image. Divide the gradient image into small blocks and calculate the variance of each block to find the first 64 of which have the largest variance. Calculate the image without reference structural clarity

$$NESS = 1 - \frac{\sum_{i=1}^{N} SSIM(x_i, y_i)}{N}$$

This formula gives nrss as an indicator for evaluating image clarity.According to the above algorithm, MATLAB is used to compare the images in 1-true, 2-fake and 3-fake in the attachment.

For the second problem, According to the given model, please distinguish the authenticity of each image in the validation.zip dataset, and use the EXCEL table to list the name of the fake image (eg: 00000001.JPEG, 00000003.JPEG)When solving this problem, the purpose of the problem is to judge the true and false of a large number of pictures. Therefore, the method used by the neural network or the support vector machine first trains the pictures in the known true and fake.

In this question, we When using svm, the images are classified based on ten evaluation indicators.The training sample is all the data of the known result. When all the known data is analyzed, the accuracy rate converges, and then all the trained results are used to judge the unknown data in the title, and the final result can be obtained.

For natural images, since the reflection characteristics of the surface of the object in the real world cause a dependence between the three color channels of the natural image, there is a high correlation between the three color channels of R, G, and B. Whenever another color of R, G, or B is used instead of another color (for example, an RBB image), blurring distortion does not occur when the obtained image is displayed, indicating that the pixel values ??of the three color channels are The change of each area of the image is synchronous. When one color transitions to another color, the pixel values of R, G, and B are also changed from one

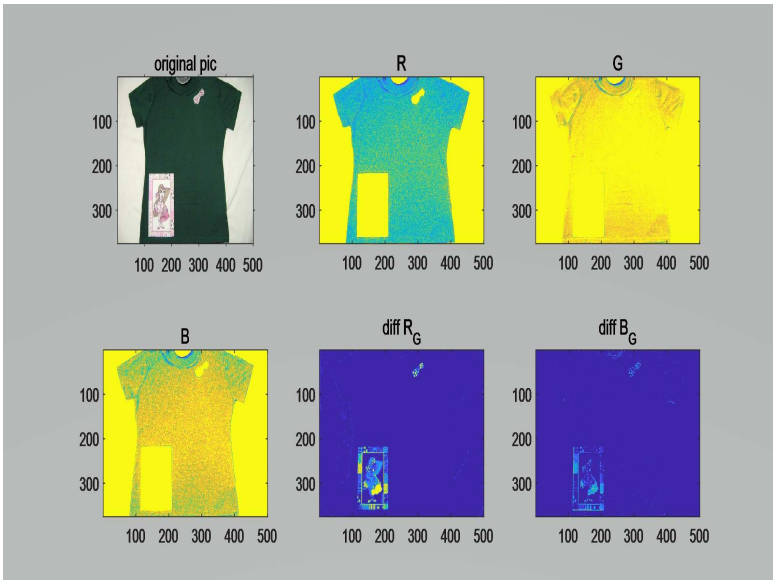

Figure 1: true pictureand and its difference picture R G B

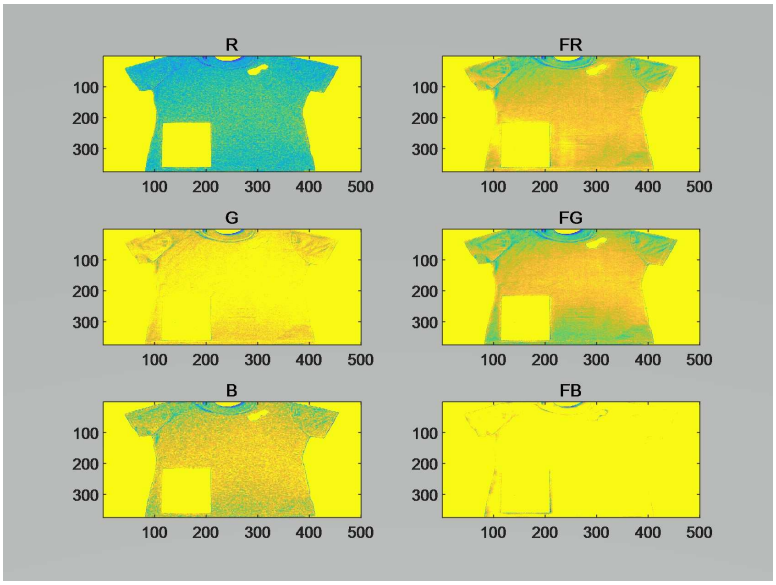

Figure 2: true pictureand and its fake picture R G B

value to another. It can be seen that the natural image three color channels are at the edge and texture. The information is consistent [9], which means that there is a high correlation between the natural image three color channels. Gunturk et al. also demonstrated this conclusion in the frequency domain [10], using a low-frequency filter $h_0 = [1/41/21/4]$ and a high-frequency filter $h_1 = [1/4 - 1/21/4]$ The two-dimensional separable filter splits the three color channels of multiple images into four sub-bands: low frequency information (LL), horizontal high frequency information (LH), vertical high frequency information (HL) And the diagonal high-frequency sub-band (HH), the correlation between the sub-bands of the R, G, and B channels is calculated. The experimental results show that the correlation between the three high-frequency sub-bands (LH, HL, HH) is high. At 0.9.

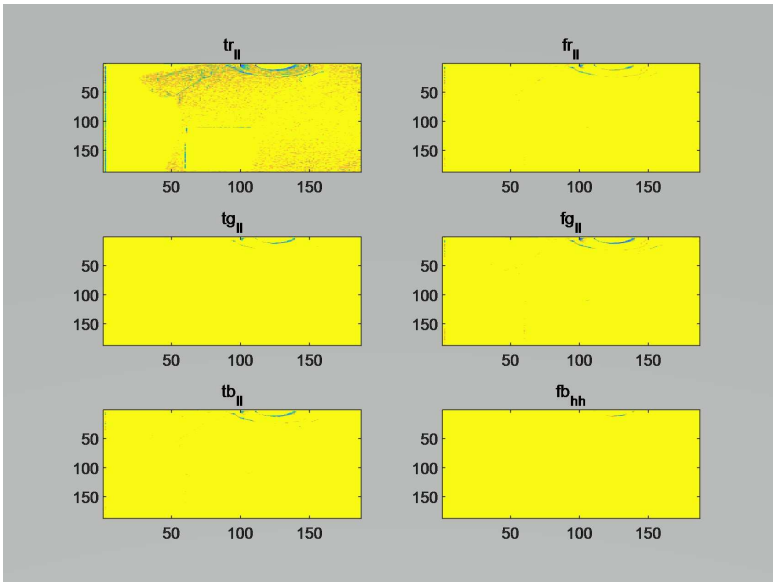

Figure 3: true and fake difference picture R G B

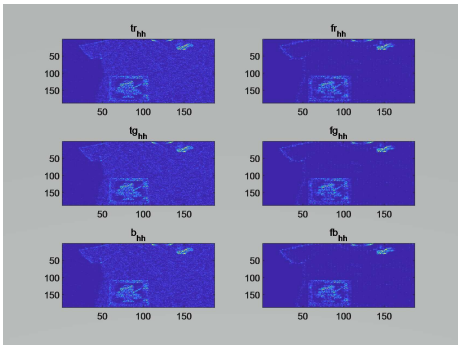

Figure 4: difference picture R G B

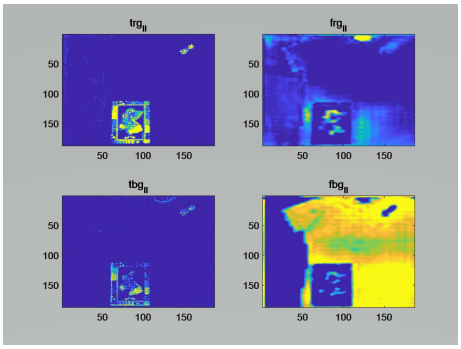

Figure 5: difference picture R G B

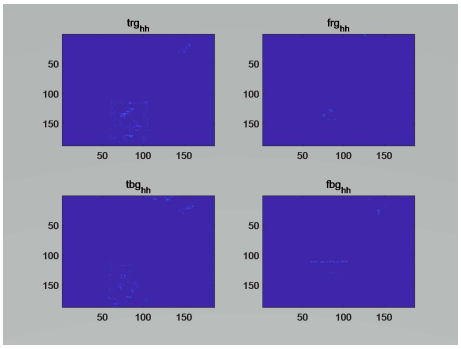

Figure 6: your caption

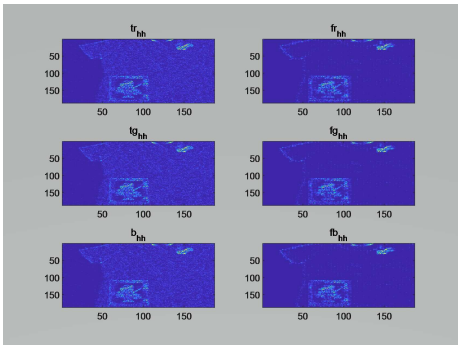

Figure 7: your caption

In the imaging process, the CFA interpolation algorithm interpolates the missing color pixel values in each color channel on the sensor. The original CFA interpolation algorithm has non-adaptive interpolation algorithm such as nearest neighbor pixel interpolation and bilinear interpolation, and bilinear interpolation algorithm. For example, the filters used for bilinear interpolation on the R,

G, and B color channels are different, hR, hG, and hB, respectively.

$$A = \begin{bmatrix} 0 & 1/4 & 0 \\ 1/4 & 1 & 1/4 \\ 0 & 1/4 & 0 \end{bmatrix}$$

$$A = \begin{bmatrix} 1/4 & 1/2 & 1/4 \\ 1/2 & 1 & 1/2 \\ 1/4 & 1/2 & 1/4 \end{bmatrix}$$

It can be seen from the above that since the CFA interpolation algorithm makes the high-frequency information between the three-color channels of the natural image have a high correlation, the correlation average value is greater than 0.98, and the difference image between the three colors tends to be flat, then It is stated that the high frequency components of the R, G, B color channels are not only highly correlated but are approximately equal to each other.

$$\boldsymbol{H}^{\mathrm{F}} - \boldsymbol{H}^{\mathrm{C}} = \boldsymbol{H}_{\mathrm{l}}^{\mathrm{F}} + \boldsymbol{H}_{\mathrm{h}}^{\mathrm{F}} - \boldsymbol{H}_{\mathrm{l}}^{\mathrm{C}} - \boldsymbol{H}_{\mathrm{h}}^{\mathrm{C}} \approx$$
$$\boldsymbol{H}_{\mathrm{l}}^{\mathrm{F}} - \boldsymbol{H}_{\mathrm{l}}^{\mathrm{C}} \approx f_{\mathrm{LPF}}(\boldsymbol{H}^{\mathrm{F}} - \boldsymbol{H}^{\mathrm{C}}) \qquad (1)$$

Figure 8

Where: fLPF represents a low-pass filter; H represents the data signal of the color channel, F and C respectively represent different color channels; l and h respectively represent the low-frequency and high-frequency information of the color channel, HF h ąÖHC h, generally In the case, C in equation (1) selects the G color component, and F selects the R and B color components. The difference image between the color channels obtained by equation (1) can be equivalent to the image passing through a low-pass filter, and the corresponding high-frequency components are filtered out, leaving only the low-frequency components. It can be easily seen from equation (1) that the color differential signal of different color channels is a low-pass, gentle signal, and the differential signal plane is also gentler at the edge than the original color channel edge, reducing the corresponding high-frequency components.

In summary, since the correlation between the three channels of the natural image r g b is very high, the correlation of the three image matrices can be directly obtained as a basis for discriminating whether the image has been processed.

However, in practice, we found that the correlation degree of the three channel images is generally higher than that of the processed images for different images, but the values of correlation between different images fluctuate greatly, which cannot be compared without reference and reference. In the case of blind detection of the picture, we use the difference image rg rb gb image of the three channels to differentiate and filter, because the natural image of the three channels is highly correlated, the difference image of the unprocessed picture The edge will be more obvious and has a certain degree of discrimination from the processed image, so the gradient calculation is performed on the filtered image after the difference and the nrss formula is applied. The value of nrss is calculated as

a value for evaluating the edge as an image feature. (2)

7.2 Model 1:problem 2

The i (i=1,...3000) training sample of the j of the training sample (j = 1...,9) the value of each indicator is denoted as a_{ij}

For a given 2000 training samples, their mean $\mu = [\mu_1, ..., \mu_9]$ and standard deviation vectors $\sigma = [\sigma_1, ...\sigma_9]$ are first calculated. All sample data are standardized using the following formula:

$$\tilde{a_(ij)} = \frac{a_(ij) - \mu_j}{\sigma_j}, j = 1, ..., 9$$

Correspondingly,

$$\tilde{x} = \frac{x_j - \mu_j}{s_j}, j = 1, ...9$$

is called standardized indicator variable. Remember for

$$\tilde{x} = [\tilde{x_1}, ...\tilde{x_{30}}]^T$$

.

Note the row vectors of 2,000 samples of known true or false after standardization

$$b_i = [\tilde{a_{i1}}, ...\tilde{a_{i9}}], i = 1, ...2000.$$

The support vector machine (SVM) model of quadratic kernel function is used for classification b_i(i∈I).

The classification function is

$$c(\tilde{x}) = \sum_{i \in I} \beta_i K(b_i, \tilde{x}) + b$$

Among$\beta_i = \alpha_i y_i; \tilde{x} = [x_1, \tilde{...}, \tilde{x_{30}}]$ $c(\tilde{x}) \geq 0$, belongs to class 1.

$c(\tilde{x}) < 0$ belongs to class 2. It is very accurate to substitute back all known sample data into the classification function. Substitute the test samples$(b_j, j = 2001, 2002, , 3000,)$ into the classification function and classify them according to the following rules: $c(b_j) \geq 0$, The JTH sample is the real image;

$c(b_j) < 0$The JTH sample is a false image; Repeat it multiple times and you get a relatively optimal function.

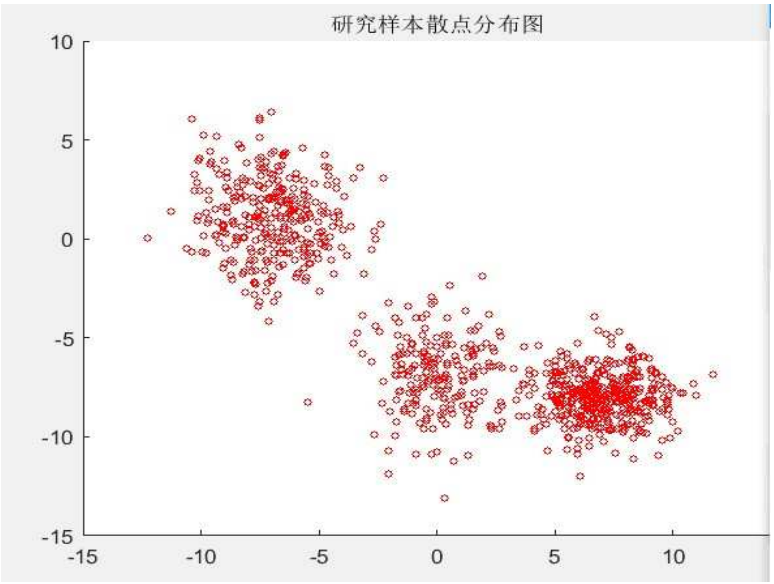

Figure 9

7.3 Model 1:BP neural network algorithm

Let x_i be a data sequence, $i = 1, 2, ..., N, N$ is the number of data samples, and n_0 is the order of the system. In order to predict the value of time i with $x_{i-1}, x_{i-2}, ..., x_{i-n_0}$, $x_{i-1}, x_{i-2}, ..., x_{i-n_0}$is used as the input of neural network. x_i is used as the output, using BP algorithm to train the data. The number of input neurons in BP network is n_i, the number of intermediate hidden layer neurons is m, u_j is the output of hidden layer neurons, and w_{ij},v_j is the output, respectively the connection weight between the input layer and the hidden layer, and the number of data samples is N(in the following formula, the superscript n represents the corresponding value of the NTH sample. 1) the input and output relationship between neurons in each layer satisfy:

$$u_j = f(\sum_{j=0}^{n_0} x_i w_{ij}), x_0 = -1$$

$$f(s) = \frac{1}{1+e^{-s}} - \frac{1}{2}$$

If the area is extremely small, then $\lambda^n > 1$, quickly disengage from the flat area, after leaving the flat area, then Return $\lambda^n = 1$. 2) Corrected error function:

$$E = 1/2[\sum_{n=1}^{N}(t^n - y^n)^2 + (1 - \frac{y^n}{t^n})^2]$$

is the actual value of the NTH sample, and $y^n$is the predicted value of the NTH sample obtained by neural network. 3) The adjustment formula of weight :

$$\delta_2^n = (y^n - t^n)(1/4 - (y^{n2} + 0.05))$$

$$v_j(k+1) = v_j(k) - \eta \sum_{n=1}^{N} \delta_2^n \mu_j^n + \alpha \Delta v_j(k)$$

$$\delta_{1j}^n = \delta_2^j v_j^n (1/4 - (u_j^n)^2)$$

$$w_{ij}(k+1) = w_{ij}(k) = \eta \sum_{n=1}^{N} \delta_i^n x_i^n + \alpha \Delta w_{ij}(k)$$

$$\eta = \frac{\phi}{N} \sum_{j=0}^{N} (\frac{\gamma}{\sum_{j=0}^{N} u_j^n(k)^2}), frag\phi = \beta \alpha pc$$

When $\Delta E > 0$, momentum factor $\alpha = 0$. But when $\Delta E < 0$, let $0 < \alpha < 1$; α is closed to one, and c is a big constant, usually evaluated between 1500 and 4000.p is number of convergence.

$$\beta = 1$$

$$\Delta E \leq 0$$

$$\beta < 1$$

$$\Delta E > 0$$

$$\Delta E = E(k+1) - E(k)$$

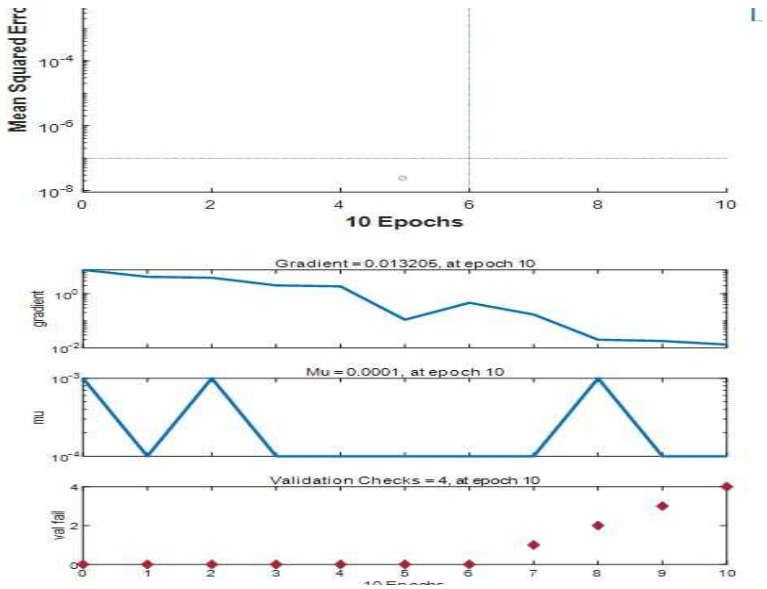

Figure 10

8 Strengths and Weaknesses

8.1 Strengths

- First one This model judges the true and false of the image by theoretically quantitative determination of the eigenvalue, complex correlation coef-

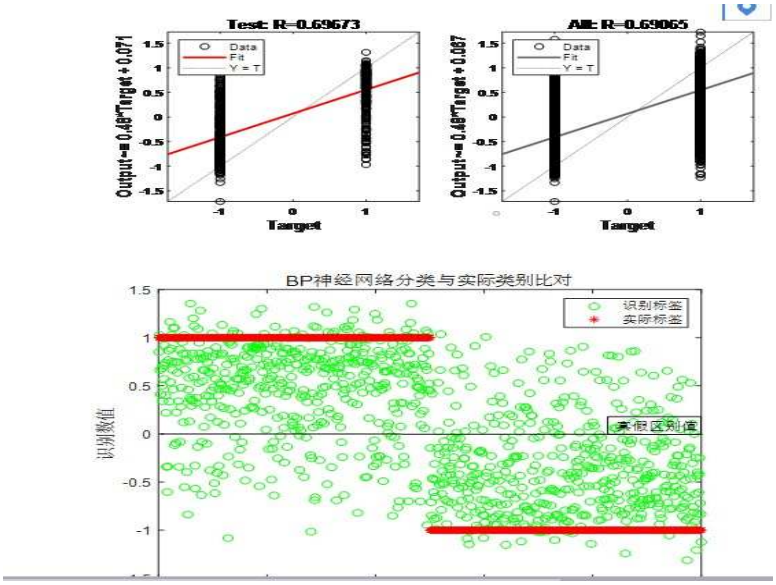

Figure 11

ficient and covariance of the matrix.Secondly, the improved algorithm performs the image on the image by judging and extracting the image waveform. Analysis, the data results are closer to the true value.

- Second one However, in practice, we found that the correlation degree of the three channel images is generally higher than that of the processed images for different images, but the values of correlation between different images fluctuate greatly, which cannot be compared without reference and reference. In the case of blind detection of the picture, we use the differential image RG RB GB image of the three channels to differentiate and filter, because the natural image of the three channels is highly correlated, the difference image of the unprocessed image The edge will be more obvious and has a certain degree of discrimination from the processed image, so the gradient calculation is performed on the filtered image after the difference and the NRSS formula is applied.

8.2 Weaknesses

- First one When using the algorithm of the future, when the wavelet is reduced in dimension, the angle of the edge of the image, the curvature, etc. will be changed to affect the image result.
- Second one In the noise reduction process, when the noise is at an important position such as the edge, the edge blur causes an influence on the authenticity of the picture.
- Third one The method used to judge the true and fake of the picture is based on the definition. When the original picture is not very clear, there is a possibility that it is mistaken for a fake picture.

9 Model optimization

In view of the shortcomings of this model, its optimization strategy can have the following operations

First one In the process of wavelet dimension reduction, if noise appears at the edge of the picture, it will have a great impact on the picture. At the same time, the algorithm is important to determine whether the picture is true by detecting the sharpness of the picture. Therefore, the picture can be Sharpen processing to better identify the true and fake pictures. Model optimization)

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