Network Communication Platform Based on Artificial Intelligence

Yongfu Liu1,*
1ShenYang University,ShenYang,110044,Liaoning,China
*Corresponding author e-mail:xliuyongfu1@syu.edu.cn

Abstract. In order to improve the integration of digital prints, this paper proposes a new method of printmaking analog synthesis, that is, using interactive technology. Firstly, Harris corner algorithm is used to collect and preprocess the adjacent feature points of digital printmaking image, and the texture features of digital printmaking image are extracted, so as to construct the texture information transmission model of digital printmaking image; Secondly, with the help of segmentation technology to process the digital print image, the dynamic feature segmentation is carried out, the local binary fitting method is used to enhance and repair the digital print image information, and the information fusion method based on interactive technology is used to complete the analog synthesis of digital print image; Finally, the simulation results show that the method has good performance of simulation synthesis and strong information fusion ability.

Key words: Digital printing, Analog synthesis; Harris corner algorithm; Segmentation technology; Interactive;

Introduction
With the development of image information technology, three-dimensional image processing technology is widely used in digital analog synthesis. Digital image reconstruction and simulation using this technology can enhance the ability of print information. At present, few people combine digital simulation with printmaking. Therefore, it is of great significance to study how to integrate digital analog synthesis method with print. Li Qian et al. [1] put forward a digital analog synthesis method of print, which mainly uses color registration simulation to realize digital analog synthesis; Qian Wenhua et al. [2] studied non photo realistic rendering technology, and showed that digital simulation has a certain influence on artistic style; Based on the analysis of the previous research, this paper proposes a new analog synthesis method, which is digital analog synthesis method based on interactive technology. The simulation results show that this method has high quality and practicability.

1.Digital image acquisition and feature preprocessing based on Interactive Technology

1.1 digital image acquisition
Digital analog synthesis can be realized by collecting and reconstructing print image information. In
this paper, the digital image of print is collected and fused, and the Ray-Casting image feature scanning method is used to scan the image, so as to get the feature points of the image. Then these feature points are de noised in subspace, and the features are extracted, so as to reconstruct the digital image contour of print, and complete the sample pixel acquisition. The digital image acquisition model of print is shown in Figure 1.

![Figure 1. digital image acquisition model of print](image)

According to figure 1, the following equations [3] are obtained:

\[ g(x, y, z) = h(x, y, z)f(x, y, z) * \eta(x, y, z) \]  \hspace{1cm} (1)

Where \( H(x, y, z) \) is the parallax function and * is the convolution function, \( \eta(x, y, z) \) represents the contour waveform. Image information is collected and fused by parallax function, and pixel intensity is obtained by recombining features [4]:

\[ g(x, y, z) = f(x, y, z) + \eta(x, y, z) \]  \hspace{1cm} (2)

According to the above formula, the digital image is simulated, and then in the contour, the image feature is transformed by image reconstruction operation. Next, the print information parameters are analyzed to obtain the difference pixel value. On this basis, the block matching technology is used to calculate the print edge pixel value, as shown in formula (3) [5].

\[ f(x, y, z) = F(x, y, z) + (1 - \beta)m_i + \delta_i^2 \]  \hspace{1cm} (3)

Among them, \( F(x, y, z) \) and \( m_i \) represent the digital simulation of print to synthesize strong and weak texture sets respectively, \( \delta_i^2 \) which means sparse local mean sparsity. Because the contour of digital analog synthesis of print changes with the change of airspace, in order to adapt to this feature, the digital image of print is collected and extracted by group sample detection technology, and interactive information fusion technology is used to realize digital modeling synthesis.

1.2 template matching and texture segmentation

There is a closed interval in the envelope profile curve, through which we can get the description of the envelope curve \( C=\{(x, y, z) \in \Omega : (x, y, z) = 0\} \) and template matching value [6]:

\[
\begin{align*}
E^c(v_i, c_2) &= \mu \int_{\Omega} \delta(\varphi(x, y, z)) | \nabla \varphi(x, y, z) | \, dx \, dy \\
+ \lambda_1 \int_{\Omega} | I - c_1 | H(\varphi(x, y, z)) \, dx \, dy \\
+ \lambda_2 \int_{\Omega} | I - c_2 | (1 - H(\varphi(x, y, z))) \, dx \, dy 
\end{align*}
\]  \hspace{1cm} (4)

Among them, \( \delta(x) \) Represents the Dirac function, and \( H(z) \) represents the Heaviside function. Before extracting texture features, we need to get the order neighbor feature points of the image. In this paper, Harris corner detection algorithm is used to get the adjacent order feature points, and then the texture features of the image are extracted by detecting the feature points and combining them. After extracting the texture features, according to the distribution of the features, the texture distribution function is obtained as follows [7]:

\[
x_{k+1, i} = \begin{cases} 
1, & \rho_{k+1, i} \leq \text{sig}(\nu_{i, d}^{k+1}) \\
0, & \rho_{k+1, i} > \text{sig}(\nu_{i, d}^{k+1}) 
\end{cases}
\]  \hspace{1cm} (5)

In the formula, \( \text{sig}(\cdot) \) represents Sig-moid function, and information filtering is carried out by
Region sample synthesis technology of three-dimensional contour to obtain the speed conversion function of image template matching [8]:

\[
sig(v_{i,d}^{k+1}) = \frac{1}{1 + e^{-\nu \cdot d_{i,d}^{k+1}}}
\] (6)

Combining the 3D data distribution and the initialization of the box model, the template matching weighting operator is constructed according to the feature quantity of 3D edge contour, as shown in equation (7) [9].

\[
c_2 \cdot \text{rand}() = \begin{cases} 1, e_p > e_{0p} \\ c_1 \cdot \text{rand}(), e_p \leq e_{0p} \end{cases}
\]

\[
c_4 \cdot \text{rand}() = \begin{cases} 1, e_g > e_{0g} \\ c_3 \cdot \text{rand}(), e_g \leq e_{0g} \end{cases}
\] (7)

C3 and C4 represent the secondary matching template of the image. The contour curve will change in the process of simulation synthesis. Considering this feature and combining with the pixel difference feature, we can segment the print texture and obtain the geometric feature distribution function of the simulation synthesis image [10]:

\[
f(x) = \omega \cdot \varphi(x) + b
\] (8)

Where b is the offset, \(\omega\) Represents the pixel feature component with uneven gray scale,. Because the image is divided into multiple templates, the segmentation technology is used to process the image template, which is convenient to match each image template, and the constraint control model is obtained

\[
\min_{\omega, b, c} J(\omega, c) = \frac{1}{2} \sum_{i=1}^{n} c_i^2 + \frac{1}{2} WTW + \frac{C}{2} \sum_{i=1}^{n} e_i^2
\] (9)

\[
y_i = \omega \cdot \varphi(x) + b + e_i, i = 1,2,\ldots,l
\] (10)

2. Digital analog synthesis method of print

2.1 Information enhancement of print digital image

According to the plate template matching to segment the three-dimensional edge contour of the image, the texture features can be extracted, and the image texture feature distribution model can be obtained

\[
E^{\text{LB}}(\varphi, f_1, f_2) = \\
\mu \int \frac{1}{2} (|\nabla \varphi| - 1)^2 \, dx + v \cdot \text{Length}(C) \\
+ \lambda_1 \int [K_\sigma(x-y) |I - f_1(x)|^2 H(\varphi) dy] \, dx \\
+ \lambda_2 \int [K_\sigma(x-y) |I - f_2(x)|^2 (1 - H(\varphi) dy] \, dx
\] (11)

In formula, \(\sigma\) Represents Gaussian function, \(K\) \(\sigma\) Represents standard deviation, \(\mu\), \(v\), \(\lambda_1\), \(\lambda_2\). They all represent the inertial parameters of the interaction information fusion. By decomposing the print image and enhancing the image information, the gradient descent flow is obtained.
\[
\frac{H\phi}{\delta(z)} = -H(\phi)[\theta(\lambda_1e_1^{LB} - \lambda_2e_2^{LB}) \\
+ (1 - \theta)(\lambda_1e_1^{LGF} - \lambda_2e_2^{LGF})] \\
+ \nu H(\phi) d\nu \left( \frac{H\phi}{H\phi} \right) \\
+ \mu (H^2\phi - d\nu \left( \frac{H\phi}{H\phi} \right))
\]

(12)

Among them, \( H(\phi) \) is the Heaviside function representing the texture of a digital printmaking image.

### 2.2 Digital Analog Synthesis of Print

Based on the enhancement and restoration of print image information, the digital simulation of print can be realized by using interactive information fusion technology. Firstly, Lagrange function is established

\[
L(\omega, b, e, a) = J(\omega, e) - \\
\sum_{i=1}^{i} a_i (\omega^T \phi(x_i) + b + e_i - y_i)
\]

(13)

In the formula, \( \alpha_i \) is the Lagrange multiplier. The pixel intensity segmentation technology is used for interactive fusion design of print image, and the classified pixel set of print image feature information is calculated, as shown in equation (13).

\[
\begin{bmatrix}
0 \\
el^T
\end{bmatrix}
\begin{bmatrix}
b \\
a
\end{bmatrix} = 
\begin{bmatrix}
0 \\
y
\end{bmatrix}
\]

(14)

Where \( I \) is the unit matrix, the key feature points are located by local mean denoising fusion detection method, and the output vector \( q_{ij} \) of digital analog synthesis of print image is obtained \( Q_{ij} = (\phi(x_i) \phi(x_j)) \). In the process of simulation synthesis, the decision function is obtained

\[
f(x) = \text{sgn}(\sum_{j=1}^{j} a_j F(x, x_j) + b)
\]

(15)

The estimated values of feature parameters are as follows:

\[
NLM[g](i) = \sum_{j=\Omega} a(i, j) g(j)
\]

(16)

### 3. Simulation Experiment

In order to verify the feasibility of the digital analog synthesis method based on interactive technology, simulation experiments are designed to verify it. Firstly, the parameters are set, and the pixel of digital image is set to \( 2000 \times 3000 \), Gaussian kernel \( \sigma \) is 7, \( \theta = 0.5 \), \( \lambda_1 \) and \( \lambda_2 \) are all 1, and the block size of template feature matching is \( 240 \times 240 \), \( \mu = 0.001 \times 255 \times 255 \). The number of learning steps of digital analog synthesis is between 100 and 400. According to the above parameters, the original image is obtained in the digital analog synthesis of printmaking, as shown in Figure 2.
The research object of the simulation experiment is the original image prints. In the process of the experiment, Harris corner detection algorithm is adopted to detect the neighboring feature points of the original image of the print, and texture features are extracted according to these feature points. Then the image is processed by image segmentation technology, and the results are obtained as follows:

After image segmentation, local binary fitting is used to enhance and repair the print image information, and interactive technology is used to complete the digital image simulation synthesis of print. The results are as follows:

It can be seen from Fig. 4 that the method proposed in this paper is feasible, and the image output quality is good and the image definition is high by using this method, which proves that the synthesis effect of this method is good.
In addition, the experiment also compares the output SNR of printmaking digital analog synthesis with that of other traditional methods, and the results are as follows:

| The number of iterations | Method of this paper | Traditional method 1 | Traditional method 2 |
|--------------------------|----------------------|----------------------|----------------------|
| 100                      | 24.4                 | 111.5                | 13.2                 |
| 200                      | 26.6                 | 14.2                 | 15.3                 |
| 300                      | 33.5                 | 17.1                 | 19.2                 |
| 400                      | 38.1                 | 19.7                 | 21.1                 |

It can be seen from the above table that under the same iteration times, in the process of digital analog synthesis of printmaking, the output signal-to-noise ratio of this method is higher than that of traditional method under the same iteration times, which indicates that the quality of digital analog synthesis of printmaking proposed in this paper is higher.

4.Conclusions
In this paper, through the digital image feature segmentation and extraction operation, and build its three-dimensional information, so as to improve the image information and digitization, so as to achieve the purpose of research. In this paper, the digital simulation synthesis method of print is realized by texture segmentation technology and Harris corner algorithm. Firstly, the feature points of digital printmaking image are detected, and its texture features are extracted on this basis. Then, the image is segmented by means of segmentation technology, and the image is processed by information enhancement and repair operation. Finally, the digital printmaking image simulation synthesis is completed. In this paper, a simulation experiment is designed to verify the digital analog synthesis method of printmaking based on interactive technology. The experimental results show that the method has good effect, high quality and strong practicability.

References
[1] Qian Wenhua, Xu Dan, Xu Jin(2020). Art style rendering of Dongba painting [J]. Journal of system simulation, no. 32 (07), pp: 1349-1359.
[2] Qian Wenhua, Cao Jinde, Xu Dan(2020). Current situation and Prospect of non photo realistic rendering technology [J]. Chinese Journal of image and graphics, no.25 (07), pp: 1283-1295.
[3] Ding Chenmei, Wang Tao, Sun Quansen(2019). interactive image segmentation algorithm based on multi-scale super-pixel and graph cut [J]. Computer and digital engineering, no.47 (12), pp: 3160-3163 + 3172.
[4] Lang Yongxiang(2020). Application of digital media interactive technology in remote control of picking robot [J]. Agricultural Mechanization Research, no.42 (10), pp: 255-258 + 268.
[5] Xue Lixia, Sun Wei, Wang Ronggui(2020). Hierarchical interactive image segmentation algorithm based on edge probability [J]. Journal of Hefei University of Technology (NATURAL SCIENCE EDITION), no.43 (03), pp: 342-348.
[6] Zheng Lei, Wu Junwei, Lin Junnian(2020). Segmentation of 3D mesh sequences with interactive label constraints [J]. Computer science, no.47 (S2), pp: 271-275 + 285.
[7] Wu Zhongqi, Guo Jianwei, Xiao Jun(2019). interactive segmentation method of mechanical model based on quadric surface fitting [J]. Journal of computer aided design and graphics, no.31 (07): 1210-1220.
[8] Lin Jiali, Liu Binghan(2019). Multi class weak annotation enhancement algorithm based on super pixel graph cut [J]. Computer engineering and design, no.40 (07), pp: 1971-1977.
[9] Zhang Huayue, Zhang Shunli, Zhang Li(2021). Interactive target segmentation algorithm based on two-stage network [J]. Computer Engineering, no.47 (02), pp: 300-306.
[10] Zhao Xiaqiang, Zhang Yuanfeng(2019). Fast image matching algorithm based on Harris corner and sift [J]. Journal of Lanzhou University of technology, no.45 (01), pp: 101-106.