Research on Multi-view 3D Image Local Region Restoration Algorithm based on Virtual Reality

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Abstract: This paper studies the local region restoration algorithm of multi-view 3D images, which lays a foundation for the analysis of image detail features. A multi-view 3D image local region restoration algorithm based on virtual reality is proposed. The texture information conduction model of multi-view 3D image is constructed. The corner matching detection of multi-view 3D image is realized by using Harris corner detection algorithm. The adaptive texture segmentation method is used to segment the local region of the image, the information enhancement method is used to repair the local region of the image, and the virtual reality technology is used to realize the local region restoration of the multi-view 3D image. The simulation results show that the proposed method has strong information compensation ability and high peak signal to noise ratio (PSNR) for local region restoration of multi-view 3D images, and it improves the recognition ability of images.

Keywords: Virtual reality; Multi-view 3D Image; Repair; Enhancement

1. Introduction

With the development of computer image processing technology, the digital image processing technology of computer graphics and imageology is gradually applied to the field of image restoration, which can realize the restoration of lost information and the present and preservation of precious image information. Image restoration is based on the principle of human vision, according to certain criteria and algorithms, the information lost and removed from the image is holographically filled and displayed. In real life, image defect is caused by improper storage over time, so image repair is needed[1]. Image restoration technology will have important application value in the fields of heritage protection, medical image information perception, film and television special effects, image target recognition and remote sensing detection. In the research of image restoration, it is the most important and difficult to repair pixel image with unknown texture feature information. The local region restoration algorithm of multi-view 3D image is studied. In the field of image restoration algorithm design, it has some vanguard and practical significance

At present, the research on image restoration is still in its infancy, and the key technologies of the relevant algorithms are not perfect and mature. The main image restoration techniques used at home and abroad focus on the establishment of a non-texture image restoration model[2]. By enhancing the contrast of the image, the bright spot model and texture feature of the target image are extracted to achieve image restoration. In reference [3], an image restoration method based on a priori feature preprocessing model is proposed, in which the most similar matching blocks are selected to replace the restoration blocks in an image. The algorithm has good gain in repairing visual lifting, but the computation is large and the realization is complex. In reference [4], the affine Markov random field is used to fill the image at pixel level to restore the image. It is feasible to repair a single object, but the algorithm consumes a lot of memory space in the modeling process, and the complexity is high. In order to solve the above problems, this paper proposes a multi-view 3D image local region restoration algorithm based on virtual reality, and it constructs a texture information transmission model of multi-view 3D image. Virtual reality technology is used to realize local region restoration of multi-view three-dimensional image. Finally, a simulation experiment is carried out to demonstrate the superior performance of the proposed method in improving the local region restoration capability of the image.

2. Texture Information and Feature Analysis of Multi-view 3D Image

2.1. Multi-view 3D image texture information transmission model

Before studying the design of local region restoration algorithm for multi-view 3D image, the texture information transmission model of multi-view 3D image structure is first designed. Firstly, it is determined from many

blocks to be repaired with edge pixels as the center[5]. A preferentially repaired block with multi-view 3D image texture structure information as $G(x,y;t)$. the intuitionistic fuzzy set of multi-view 3D image texture subspace is defined as conduction function:

$$p(x,t)=\lim_{\Delta x\to 0}[s\ \frac{u-(u+\Delta u)}{\Delta x}]=-s\ \frac{\partial u(x,t)}{\partial x} \quad (1)$$

In the upper formula, s is expressed as the fuzzy heat flux of the multi-view 3D image texture structure in unit time, Δx represents the visual difference of the edge information of the multi-view 3D image, and Δu represents the conduction coefficient. Assume that the edge information of the multi-view 3D image along the gradient direction is as follows:

$$G_x(x,y;t)=\partial u(x,y;t)/\partial x \quad (2)$$

The zero uniform ergodic property in the objective function is obtained, and the information flow density vector of the multi-view 3D image texture structure is obtained as follows:

$$\begin{aligned} p(x,y;t)&=-s\nabla u(x,y;t)=-s\ G(x,y;t)\\ &=-s\ [G_x(x,y;t)i+G_y(x,y;t)\ j] \end{aligned} \quad (3)$$

Wherein, i,j are the unit direction vectors, based on the intuitionistic fuzzy set multi-view 3D image structure texture information conduction model, the zero uniform ergodic characteristic and the logical difference variable scale characteristic in the objective function are obtained to obtain the partial derivative of the center. The information to be repaired is divided into horizontal and vertical conduction sub-regions along the propagation direction, so that a multi-view 3D image can be selected from a large number of sample blocks in the intact area to find an optimal sample with the highest priority of the current block to be repaired. In the current repaired block, the partial derivative of the center is obtained by solving the zero uniform ergodic property in the objective function and the variable scale characteristic of the logical difference[6]. When the derivative is zero, the texture information of 3D image structure based on intuitionistic fuzzy set is introduced to repair the image.

2.2. Corner matching of multi-view 3D images

The texture information conduction model of multi-view 3D image is constructed, and the corner detection equation of multi-view 3D image is described as follows:

$$\begin{cases} f(x_1,x_2)=r_1x_1(1-\dfrac{x_1}{N_1}-s_1\dfrac{x_2}{N_2})=0\\ g(x_1,x_2)=r_2x_2(1-s_2\dfrac{x_1}{N_1}-\dfrac{x_2}{N_2})=0 \end{cases} \quad (4)$$

Firstly, the edge pixel is updated, and the multi-view 3D image is repaired until there are no edge pixels. The iterative equation of multi-dimensional search for sub-space feature information is described as follows:

$$u^{(n+1)}(x,y)=u^{(n)}(x,y)+d\,u_1^{(n)}(x,y) \quad (5)$$

$$u_1^{(n)}(x,y)=M\Delta_s u^{(n)}(x,y)+N\Delta_t u^{(n)}(x,y;d) \quad (6)$$

In the upper expression, $n=1,2,...,T$, is the number of iteration steps, T is the total number of iterations, $u^{(n)}(x,y)$ is the pixel value, d is the update speed. The size of the multi-view 3D image to be repaired is assumed to be $u^{(n)}(x,y;d)$, and the size of the block Ψ_p to be repaired is $s\times s$. Through the above iterative search, the priority of pixel points in the position to be repaired can be determined.

3. Optimization of Image Restoration Algorithm

3.1. Adaptive texture segmentation

In this paper, a virtual reality based local region restoration algorithm for multi-view 3D images is proposed[7]. In order to maintain the continuity of repair of damaged areas in multi-view 3D images, the confidence of the repaired points must be updated. The updated criteria are as:

$$I(y)=C(p),\quad \forall y\in \Psi_p\cap\Omega \quad (7)$$

The average number of edge pixels to calculate the priority coefficient of the block to be restored is divided into texture segmentation and feature partition, and the image restoration is carried out by the detail feature decomposition and the wavelet packet reconstruction method. The two value multi-dimensional image with uniform angle distribution of the multi view 3D image is assumed, and the image point bureau is assumed. The autocorrelation function of the image is:

$$c(x,y)=\sum\nolimits_W[I(x_i,y_i)-I(x_i+\Delta x,y_i+\Delta y)]^2 \quad (8)$$

Where, $(\Delta x,\Delta y)^T$ is the aperture displacement of the host image, and the (x_i,y_i) is a texture pixel embedded in the low frequency window W, the information characteristic conduction approximation value of multi-view 3D images is:

$$\begin{aligned} &I(x_i+\Delta x,y_i+\Delta y)\approx\\ &I(x_i,y_i)+\begin{bmatrix} I_x(x_i,y_i) & I_y(x_i,y_i)\end{bmatrix}\begin{bmatrix}\Delta x\\ \Delta y\end{bmatrix} \end{aligned} \quad (9)$$

Where, $\nabla I=\begin{bmatrix} I_x & I_y\end{bmatrix}^T$, x,y $\in$ (0,1,$\cdots$ L-1), show the spatial gradient value and the intrinsic modal functions of the multi-view 3D images.

3.2. Image enhancement and local region restoration implementation

Combined with Adaptive texture Segmentation method for Image Local region Segmentation, Information Enhancement method is used to deal with the information of local region of the image, and the image of each component of the original image is obtained. Texture information is:

$$c(x,y)=[\Delta x \quad \Delta y]\begin{bmatrix}\sum_W I_x^{\,2} & \sum_W I_x I_y \\ \sum_W I_x I_y & \sum_W I_y^{\,2}\end{bmatrix}\begin{bmatrix}\Delta x \\ \Delta y\end{bmatrix} \tag{10}$$

By adjusting the size and center of the template, the information conduction function of the multi-view 3D image is obtained as follows:

$$p(x,t)=\lim_{\Delta x\to 0}[s\ \frac{u-(u+\Delta u)}{\Delta x}]=-s\ \frac{\partial u(x,t)}{\partial x} \tag{11}$$

The pixel mean value is obtained by single scale Harris corner detection.

$$A\ =\ s\begin{bmatrix}\cos q & -\sin q \\ \sin q & \cos q\end{bmatrix}, t=\begin{bmatrix}t_x \\ t_y\end{bmatrix} \tag{12}$$

The angle contour feature of the edge amplitude in the plane pheromone is $G(x,y;t)$, in which:

$$u(x,y;t)=G(x,y;t) \tag{13}$$

$$B_{1W}(i,j)=\begin{cases}1, & if CD22_L(i,j)>CD22(i,j)\\ 0, & if CD22_L(i,j)<CD22(i,j)\end{cases} \tag{14}$$

The difference grayscale compensation of multi-view 3D image is carried out, and the scale space of the image is obtained as follows:

$$M_{i,j}=med(X_{i-1,j-1}\ \mathbf{L}\ X_{i,j}\ \mathbf{L}\ X_{i+1,j+1}) \tag{15}$$

Where, A is point separation phase characteristic, $A=\{a_{i,j},0<i,j<N\}$, so that the implementation flow for obtaining the repair of the map item is shown in figure 1.

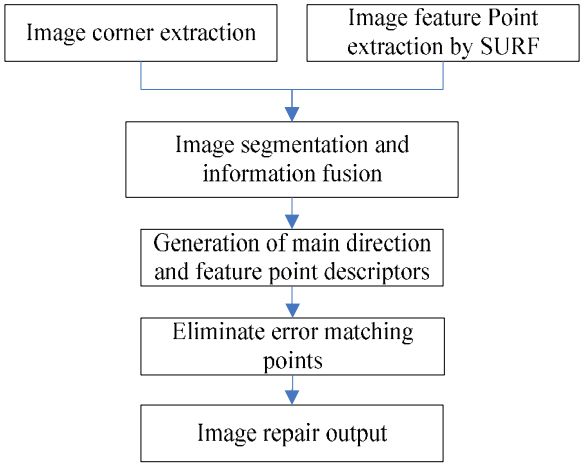

Figure 1. Implementation process of local area repair for image

4. Simulation Experiment Analysis

In order to test the performance of this algorithm in the realization of local region restoration of multi-view 3D images, the simulation experiment is carried out, and the mathematical programming is carried out by using Matlab image processing software. The sampling rate of D/A is 3.5 Hz, and the aperture is F14, in which the sampling rate is 3.5 Hz and the aperture is F14. When the exposure time is 13 s, the A/D input signal should be 0 ~ 4 dB light intensity signal. The algorithm of this paper is used to repair the local region of the multi-view 3D image, and the Visual DSP is configured to simulate the image processing. Based on the above simulation environment and parameter design, the original image is shown in figure 2.

Figure 2. Original image

In figure 2, there is a lack of information in the image. The method of this paper is used to repair the image, the texture information conduction model of the multi-view 3D image is constructed, and the gray level of the multi-view 3D image is realized by using the Harris corner detection algorithm. The result of image restoration is shown in figure 3.

It can be seen from the graph that the method of this paper is used to carry out the image restoration, to realize the image detail feature matching, to have better repair ability to the missing information, to restore the detail feature better, to test the repair performance of different methods. The output PSNR value is analyzed and the comparison results are shown in figure 4. The analysis figure 4 shows that the output PSNR value of this method for image restoration is higher, which shows that the repair ability is stronger.

5. Conclusions

In this paper, a multi-view 3D image local region restoration algorithm based on virtual reality is proposed. The texture information conduction model of multi-view 3D

image is constructed. The corner matching detection of multi-view 3D image is realized by using Harris corner detection algorithm. The adaptive texture segmentation method is used to segment the local region of the image, the information enhancement method is used to repair the local region of the image, and the virtual reality technology is used to realize the local region restoration of the multi-view 3D image. The simulation results show that the proposed method has strong information compensation ability in practice.

Figure 3. Image repair results

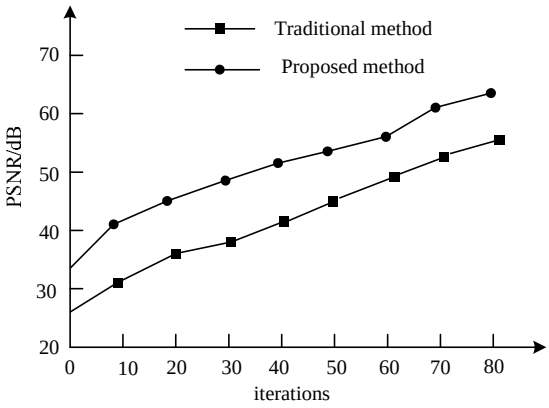

Figure 4. PSNR comparison

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