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Retraction

Retracted: The Application of Immersive Interactive Technology in Animation Teaching

Advances in Multimedia

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This article has been retracted by Hindawi, as publisher, following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of systematic manipulation of the publication and peer-review process. We cannot, therefore, vouch for the reliability or integrity of this article.

Please note that this notice is intended solely to alert readers that the peer-review process of this article has been compromised.

Wiley and Hindawi regret 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 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] Z. Sun and J. Liu, "The Application of Immersive Interactive Technology in Animation Teaching," *Advances in Multimedia*, vol. 2023, Article ID 1611497, 9 pages, 2022.

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Research Article

The Application of Immersive Interactive Technology in Animation Teaching

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In order to improve the interactive and immersive effect of animation teaching, this paper applies immersive interactive technology to animation teaching. In the light processing of animation teaching, this paper uses four-step phase shift and PCA algorithm to process the interference fringes with vibration effects collected by the CCD camera. The influence of white light background noise in the environment on the laser speckle measurement can be effectively filtered by adding a filter device to the imaging optical path. In order to explore the antivibration ability of different phase extraction algorithms of laser speckle interferometry in the presence of vibration in the measurement environment, this paper constructs an application model of immersive interactive technology in animation teaching. From the test results, it can be seen that the application effect of the immersive interactive technology proposed in this paper in animation teaching is relatively obvious.

1. Introduction

Animation is a combination of culture, art, and modern information technology. In order to better develop the animation industry, we need the support of professional talents. As far as animation production technology is concerned, animation production is a professional technology, which requires not only a higher technical level but also a higher aesthetic ability. Only in this way can the animation image be more vivid and conform to the characteristics of animation, thereby improving the competitiveness of animation, gaining market favor, and further winning the market [1]. In the current animation production technology major in colleges and universities, it is still difficult for talents trained through school education to meet the job requirements of animation industry-related enterprises. Therefore, it is necessary to start from practical teaching to analyze and constantly find problems, so as to formulate targeted strategies in the process of reform [2].

The process of animation production involves many aspects. Students need to learn various courses such as audio-visual language, animation motion law, two-dimensional animation design, film and television special effects design, postproduction synthesis, and other courses. Due to the different teaching contents of the courses, the training objectives for students are also different. It is even more necessary for teachers to formulate a clear course teaching direction, so that students can adapt to the needs of professional development through learning and adapt to the needs of professional positions after entering career positions. However, from the actual situation of teaching, college students cannot grasp the primary, secondary, and key points of learning in the process of learning [3]. Although most students are familiar with and understand the various processes and technologies of animation production, they are not proficient in the actual application process, so it is difficult for students to produce good animation works [4].

In the process of teaching animation production technology, teachers are not only required to have a high level of animation production technology but also require teachers to have high educational and teaching organizational skills, so that teachers' professional ability and animation production design concepts can be passed on to the students [5]. However, from the actual situation, it is difficult for college teachers to unify the two aspects of professional ability and teaching ability. Some teachers have strong professional ability and have superb technical level in all aspects of animation production technology, but teachers' teaching organization ability is slightly. There are deficiencies, it is difficult to take scientific and reasonable methods to implement efficient teaching for students in course teaching, which makes it difficult for students to learn the essence of technology [6]. On the contrary, some teachers have strong educational and teaching organizational skills and can implement teaching with a variety of curriculum teaching strategies, but teachers' own teaching and research capabilities need to be improved, making it difficult for students to grasp the most cutting-edge technologies in the process of learning, which also affects the student's technical learning. In addition, in the process of continuous development of technology, more and more enterprises are constantly applying cutting-edge technology to make animations, but the technology and software used in the process of school education are relatively backward, which makes it difficult for students to meet the needs of enterprises after learning. Development needs, most students often need to learn from scratch after entering the enterprise after studying in school, it is difficult to adapt to the needs of job development [7].

According to the training goals and concepts of animation professionals, the analysis of virtual teaching shows that in the process of teaching activities, for teachers, they should continue to learn new knowledge, strengthen their understanding and application of virtual reality technology, and be able to use it in teaching. In the process, new teaching methods such as simulation are introduced, so that students can carry out a more interesting learning process under relatively realistic environmental conditions, so that they can generate the inner motivation to explore the nature of things, and make full use of technology to guide students to understand the nature of things. Feeling and exploring, guide them to explore from the surface to the inner, gradually summarize the basic laws of the development of things, and discover the inner relationship between things and the surrounding things [8]. The effective application of this technology can promote the diversification of teaching activities, give educated students a stronger sensory experience, enable students to master more professional knowledge, and improve their professional skills. It can be seen that under the development of virtual reality technology, virtual teaching has become a huge change in the field of education and teaching [9].

According to the training goals and concepts of animation majors, in the process of applying virtual reality technology to the construction of animation majors, strengthen the cultivation of the practical ability of the educated, and carry out more diverse practical activities, so that the cultivation of practical ability can be achieved in the rich and colorful activities. Implement and expand the channels for cultivating practical ability [10]. With the support of virtual reality technology, teachers can create a variety of training environments, and the training environment has a high degree of authenticity, which can better attract the attention of the students, and make them extremely interested in learning and inquiry. The great reinforcement enables them to have the intrinsic motivation to actively participate, to carry out various technical practices automatically and spontaneously in the virtual environment, and to continuously plan, implement, and verify the design scheme according to the guidance of the teachers [11].

For a long time in the past, when cultivating educated animation practice ability in many cases, due to various objective conditions, the learning effect will be seriously reduced. For example, in bad weather or lack of ideal practice bases, it is difficult for teachers to organize practical activities effectively, which will seriously shorten the time for practice development, so that the needs of educated students in terms of practical training cannot be met, and the development of their practical ability will also be difficult and weakened. In addition, if the practice activity itself takes a long period of time, the process and results of the cultivation cannot be significantly manifested in a relatively short period of time, so that the long practice period cannot obtain strong support [12].

The introduction of virtual reality technology in colleges and universities can significantly increase the time for animation professional practice, which can not only overcome the shortcoming of training time but also break through the constraints of training time [13]. On the one hand, the virtual environment gives students the possibility to enter and exit at any time and repeatedly, and this kind of practical training can be carried out without barriers. Although the environment is virtual, it can give students a more realistic experience and feeling, effectively increasing their training, and positive experience in practice. On the other hand, with the help of virtual reality technology, many other problems can be solved, such as overcoming the long period of animation practice [14]. For example, construction site inspection, the inspection of the construction site is limited by the construction period and the construction and construction progress during the construction period. In a short-term inspection, only a certain link in a certain construction period can be seen. If students cannot watch the entire construction process in a short period of time, they will not be able to participate effectively. The participation of virtual reality technology can break through objective constraints such as time, adjust the constraints of practical progress and time based on practical needs, and greatly reduce the difficulty of carrying out long-cycle practical activities [15].

In the process of carrying out the practice, some places are inherently dangerous and cannot be entered, touched, or even directly observed in the real environment. However, with the help of virtual reality technology, the possible dangers in the above practice can be well resolved, so that these places can carry out practical activities in a virtual form, so that when educated design, they can realize the it can be used in places, but it can avoid operational risk factors [16]. In the production process of architectural tours for animation majors, in order to ensure the safety of the educated as much as possible, they are usually not allowed to go to the construction site, so animation majors are usually unable to go to carry out dangerous practical activities, so they cannot escape from these environments. Accumulate useful experience and knowledge, and the use of virtual reality technology can solve such problems well. For example, some design training itself is difficult to control effectively in reality, or has greater danger, you can choose to carry out virtual practice first. The training method enables students to master and become familiar with the necessary skills and operations, and then can judge whether it is necessary to organize their practice in the real environment based on the actual situation, which greatly improves the safety of students' practice [17].

This paper applies immersive interactive technology to animation teaching, improves the effect of animation teaching in colleges and universities, and promotes students' understanding of animation teaching knowledge.

2. Anime Immersive Teaching Light Sensing Algorithm

2.1. Animation Light Interference Topography Measurement Technology. In the animation light interferometry experiment of the surface topography of plasma-oriented components (PFCs) of the tokamak fusion device, since the morphology of the sample to be measured is an out-of-plane physical quantity, the experimental optical path used in the animation light interferometry system built under laboratory conditions is based on the Michelson interference optical path shown in Figure 1. Its basic components are helium-neon laser, piezoelectric ceramic displacement sensor (PZT) for introducing displacement for reference light, photoelectric coupling device (CCD camera) for recording the intensity distribution of interference fringe pattern, and beam splitter for dividing the laser into two and several lenses.

In an experiment on the deformation of the topography of plasma-facing components (PFCs) within an animated light interferometry fusion device, information containing the topography of the sample to be measured is included in the intensity information of the fringe pattern. The electric field strengths of the reference laser and the probe laser are as follows:

$$E_1 = |E_1| \cos(2\pi f t + \varphi_1),$$
$$E_2 = |E_2| \cos(2\pi f t + \varphi_2). \quad (1)$$

Among them, $|E_1|$ and $|E_2|$ are the amplitudes of the reference light and probe light, respectively, and φ_1 and φ_2 are the wavefront phases of the reference light and probe light, respectively. After the two interfere, the intensity distribution on the interferogram is as follows:

$$I = |E_1 + E_2|^2 = |E_1|^2 + |E_2|^2 + 2|E_1 E_2| \cos(\varphi_1 - \varphi_2) \cos(4\pi f t + \varphi_1 + \varphi_2). \quad (2)$$

Since the frequency of the laser is high (10^14 Hz) and CCD does not respond, the intensity distribution of the animation ray image collected by the CCD camera can be written as follows:

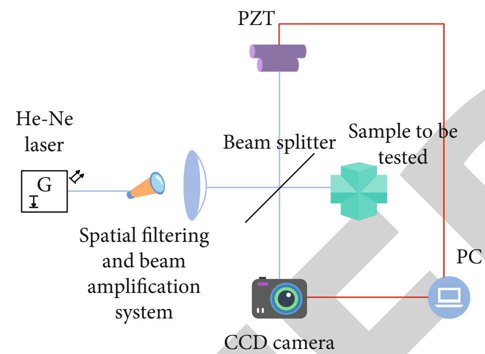

Figure 1: Animation light interferometry system.

$$I_{\text{before}} = |E_1|^2 + |E_2|^2 + 2|E_1 E_2| \cos(\varphi_1 - \varphi_2). \quad (3)$$

When the surface of the object is displaced or deformed, the light intensity distribution of the interference fringes collected by the CCD camera can be written as follows:

$$I_{\text{after}} = |E_1|^2 + |E_2|^2 + 2|E_1 E_2| \cos(\varphi_1 - \varphi_2 + \Delta\varphi). \quad (4)$$

Among them, $\Delta\varphi$ is the phase change induced by the displacement or deformation of the surface of the object to be measured. If we want to measure the displacement and deformation of the object surface, we need to measure the surface topography before and after the displacement or deformation, that is, double-exposure animation light interference technology. Taking the four-step phase shift as an example, eight-animation light interference fringe patterns need to be collected. After that, $\Delta\varphi$ is extracted from these eight interferograms, and then according to the optical path difference formula

$$\Delta Z(x, y) = \frac{\lambda}{4\pi} \Delta\varphi(x, y). \quad (5)$$

Among them, $\Delta Z(x, y)$ is the out-of-plane displacement or deformation of the sample to be measured, and λ is the laser wavelength.

2.2. Phase Extraction Method. The phase information in the interferogram is extracted by fringe center positioning and fringe series counting methods, such as the fringe skeleton method. This method needs to obtain the position of the fringe center on the interference fringe image to determine the phase of each point. This processing method requires manual processing, and the measurement resolution is low and the precision is poor. Moreover, to obtain the phase of each point between adjacent stripes, it needs to be obtained by interpolation, so the application is limited. At the same time, when there is less than one fringe in the field of view, the fringe series can no longer be used to extract the phase. In order to make up for the above

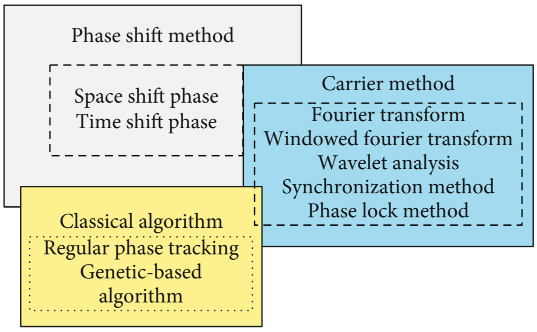

Figure 2: Phase extraction method.

deficiencies, a variety of phase extraction methods as shown in Figure 2 have been developed.

In this paper, the step-by-step time phase-shift interferometry is used, and the spatial distribution of the intensity of the collected interference fringe pattern can be expressed as

$$I_n(x,y) = A(x,y) + B(x,y)\cos\left[\varphi(x,y) + \delta_n\right](n = 1, 2, \cdots, N, N \geq 3). \quad (6)$$

Among them, $I_n(x,y)$ represents the spatial intensity distribution of the interference pattern, $A(x,y)$ represents the background intensity, $B(x,y)$ represents the modulation degree of the interference image, and $\varphi(x,y)$ represents the phase to be measured. We assume that M interference images are collected at equal intervals in a cycle, and multiply the left and right sides of the above equation by $\cos\delta_n$ and $\sin\delta_n$, respectively. Then, M times of accumulation are performed, and the phase can be obtained by using the orthogonality of the trigonometric function.

$$\varphi(x,y) = \tan^{-1}\frac{\sum_{n=1}^{M} I_n \sin\delta_n}{\sum_{n=1}^{M} I_n \cos\delta_n}. \quad (7)$$

It is evident from the above equation that the wrapping phase is derived from the sine and cosine components of the intensity signal.

Collecting multiple interference patterns for phase extraction is the first step in topography measurement. Since the phase extracted according to the intensity information is wrapped between −?/2 and ?/2, then it is necessary to perform phase unwrapping using the phase unwrapping technique for the extracted wrapped phase, which is the second step. The third step is to reuse the mathematical relationship between the unfolded phase and the three-dimensional topography to obtain the correct three-dimensional topography information, and then obtain the three-dimensional topography of the sample.

The phase distribution obtained by the phase-shift interferometry can be expressed as follows:

$$\varphi(x,y) = \tan^{-1}\frac{S(x,y)}{C(x,y)}. \quad (8)$$

This phase distribution is located in the $(-\pi/2, \pi/2)$ range, according to the signs of $S(x,y)$ and $C(x,y)$.

After extracting the wrapped phase, in order to obtain the continuous phase, the wrapped phase needs to be phase unwrapped, that is, the phase unwrapping operation is performed. When the absolute value of the phase difference between adjacent pixels exceeds π, the phase discontinuity is eliminated by increasing or decreasing the phase of an integer multiple of 2π. The relationship between the continuous phase and the wrapped phase in the $0 \sim 2\pi$ range is as follows:

$$\phi(x,y) = \varphi(x,y) + 2n(x,y)\pi. \quad (9)$$

In the formula, $n(x,y)$ is an integer. The specific phase unwrapping process is as follows:

Wrapped phases $\varphi(x,y)$ and corresponding continuous phases $\phi(x,y)$ is shown in Figure 3.In animation light interferometry, there will be unavoidable noise problems, resulting in low signal-to-noise ratio of local sampling. Therefore, sometimes the wrapping phase extracted from the animation light interferogram is distorted and broken, which has an adverse effect on the measurement results. For path correlation algorithms, failure to identify this situation will result in the propagation of errors, which in turn will lead to the failure of unwrapping. Therefore, it is necessary to propose an algorithm that can still solve the continuous phase well for the wrapped phase map containing the noise. The specific calculation rules of the quality parameters are as follows:

The unwrapping process of the quality-guided anime color filling algorithm is shown in Figure 4.The calculation process of the four-step phase-shifting algorithm for extracting the phase is quite simple, and it is quite a common method for extracting the phase in the step-time phase-shift interferometry technique. This method uses piezoelectric ceramics (PZT) to sequentially introduce a phase shift amount $\pi/2$ into the reference light.

2.3. Principal Component Analysis Algorithm. Principal Component Analysis (PCA) was first introduced by Pearson in the study of nonrandom variables, and Hotelling later extended this method to random vectors.

Obviously, the intensity signal at any point on the interferogram contains the sum of three parts, which are a DC signal and two mutually orthogonal AC signals. The first two principal components (which have the largest eigenvalues and are orthogonal to each other) that can be extracted from the intensity signal by the PCA algorithm are the AC signal $I_c = b\cos\varphi, I_s = b\sin\varphi$. The envelope phase can be obtained as follows:

$$\varphi_{\text{wrapped}} = \tan^{-1}\frac{I_s}{I_c}. \quad (10)$$

From the above principle of extracting phase, it can be seen that the algorithm does not introduce a constant phase shift value like the four-step phase shift algorithm, and the phase shift value does not need to be constant, that is, it is immune to the phase shift error.

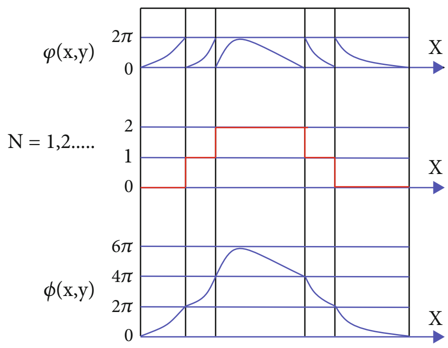

FIGURE 3: Wrapped phases $\varphi(x, y)$ and corresponding continuous phases $\phi(x, y)$.

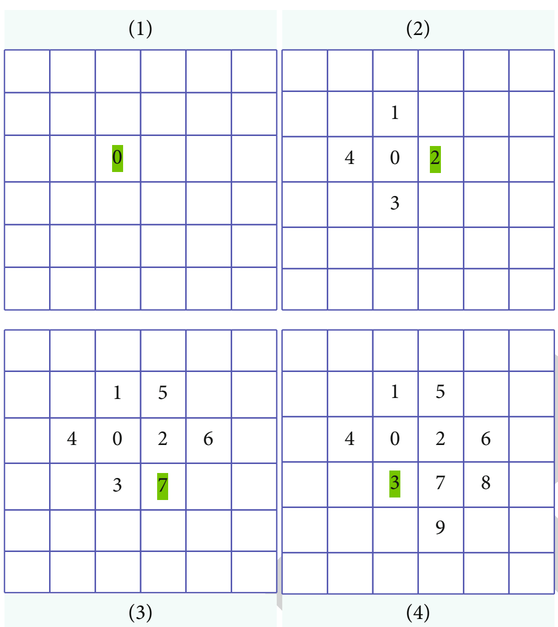

FIGURE 4: The unwrapping process of the quality-guided anime color filling algorithm.

2.4. Theoretical Analysis of the Effect of Different Sampling Times on Interference Fringes. When the sample to be tested is in a vibrating environment, the surface morphology of the sample is not stable but changes with time, and the surface topography $Z'(x, y, t)$ is the superposition of the sample topography $Z_0(x, y)$ and the amplitude $A(x, y, t)$ when it is stationary.

$$Z'(x, y, t) = Z_0(x, y) + A(x, y, t). \tag{11}$$

For time-phase-shift interferometry, although the measurement accuracy is high, it needs to collect multiple interferograms. In the multiple sampling processes under vibration, the topography $Z'(x, y, t)$ changes with time, so it is not suitable for dynamic measurement. For the dynamic measurement of animation light shear measurement and animation light carrier measurement, it is also necessary to

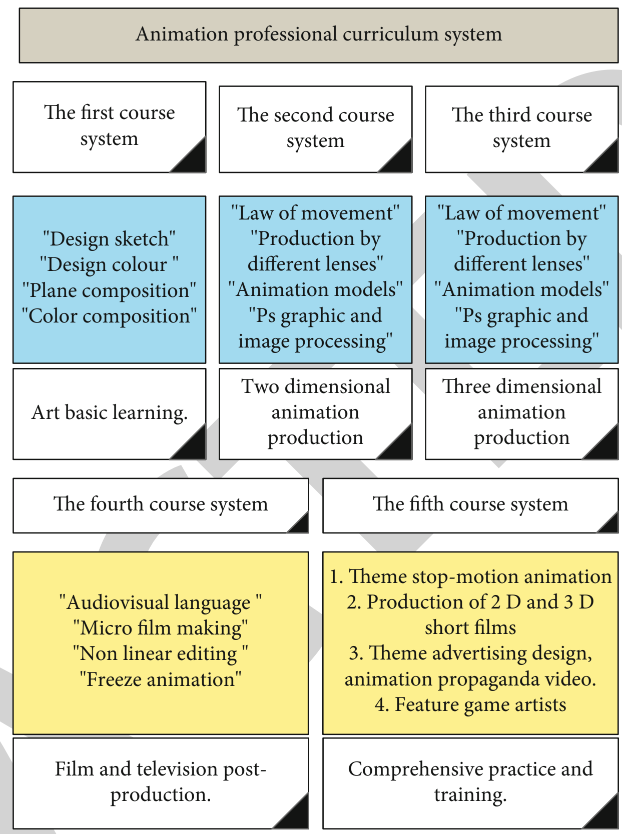

FIGURE 5: Construction diagram of the animation major curriculum system.

analyze the influence of vibration on the intensity distribution and contrast of interference fringes.

Firstly, the environmental vibration is simplified and analyzed. If we assume that the surface topography of the sample to be measured is vibrating out of the plane with respect to an average position, the expression of the spatial variation of the vibration displacement can be simplified as follows:

$$A(x, y, t) = |A(x, y)| \cos(\mathrm{wt}). \tag{12}$$

Among them, $|A(x, y)|$ is the amplitude of vibration, and $|A(x, y)|$ is different in different positions, $w = 2\pi f$ is the angular frequency of vibration, and f is the frequency of vibration. Then, the vibration speed is as follows:

$$v(x, y, t) = \frac{\mathrm{dA}}{\mathrm{dt}} = -w|A(x, y)| \sin(\mathrm{wt}). \tag{13}$$

When an object that emits or reflects a certain frequency of sound waves or electromagnetic waves moves relative to the receiver, the frequency of the wave received by the receiver will change with the speed of the relative motion. This frequency change with speed is called the Doppler shift effect. The Doppler shift of the laser due to the vibrational

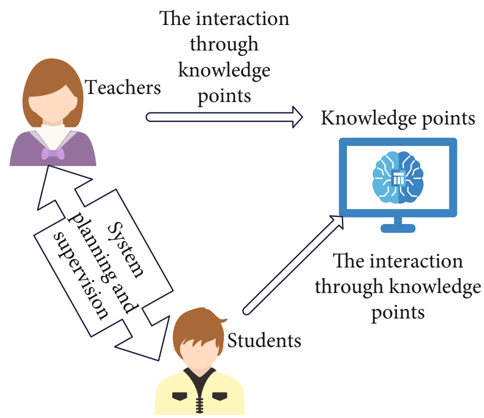

Figure 6: Immersive learning system.

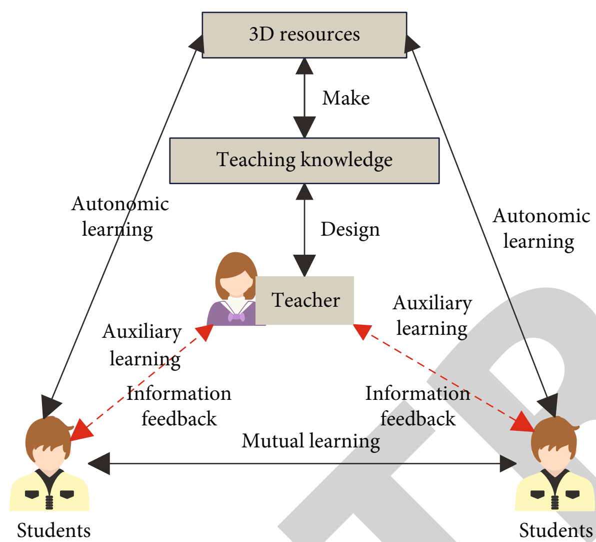

Figure 7: Immersive teaching relationship under constructivism.

velocity of the object is as follows:

$$\Delta f_D(x, y) = \frac{2v}{\lambda} = \frac{-2w|A(x, y)| \sin (\mathrm{wt})}{\lambda}. \quad (14)$$

The electric field strengths of the reference laser and the probe laser in the Michelson optical path are

$$E_1 = |E_1| \cos (2\pi f_1 t + \varphi_1) E_2 = |E_2| \cos (2\pi f_2 t + \varphi_2). \quad (15)$$

After the two interfere, the light intensity is

$$I(x, y, t) = |E_1|^2 + |E_2|^2 + 2|E_1 E_2| \cos [2\pi (f_1 - f_2) t + \varphi_1 - \varphi_2]. \quad (16)$$

It can be seen from the formula that the light intensity under vibration varies with time. If the frequency change Δf_D is much larger than the frequency resolution of the detector, the last term on the equation is averaged to zero, and the average intensity is $\langle I \rangle = |E_1|^2 + |E_2|^2$ at this time. If the frequency change Δf_D is within the frequency range of the detector, the magnitude of the detector output intensity will fluctuate between $I_1 + I_2 - 2\sqrt{I_1 I_2}$ and $I_1 + I_2 + 2\sqrt{I_1 I_2}$ with time. The phase of this oscillation is determined by $(\varphi_1 - \varphi_2)$, so the phase of the measured intensity change holds.

$$\Delta f_D \Delta t < 1. \quad (17)$$

After considering the Doppler frequency shift caused by the vibrating target and the sampling time Δt of the CCD camera, the formula of the output light intensity can be written as follows:

$$I(x, y, \Delta t) = \frac{1}{\Delta t} \int_0^{\Delta t} I(x, y, t) = |E_1|^2 + |E_2|^2 + \frac{1}{\Delta t} \int_0^{\Delta t} 2|E_1||E_2| \cos [2\pi \Delta f_D t + \varphi_1 - \varphi_2] \mathrm{d}t. \quad (18)$$

Among them, the phase of the reference light is $\varphi_1(x, y)$, and the phase of the probe light is $\varphi_2(x, y, t) = 4\pi/\lambda (Z_0 + |A(x, y)| \cos (wt))$. It can be known from the formula that the phase difference during vibration is

$$\begin{aligned} \Phi' &= \varphi_1 - \frac{4\pi}{\lambda} Z_0 - \frac{4\pi|A| \cos (\mathrm{wt}) + 2\pi \Delta f_D t}{\lambda} \\ &= \Phi_0 - \frac{4\pi|A| \cos (\mathrm{wt}) + 2\pi \Delta f_D t}{\lambda}, \end{aligned} \quad (19)$$

then

$$I(x, y, \Delta t) = |E_1|^2 + |E_2|^2 + \frac{1}{\Delta t} \int_0^{\Delta t} 2|E_1||E_2| \cos [\Phi_0 + \Phi_1] \mathrm{d}t. \quad (20)$$

Among them, the phase difference when the sample to be tested is stationary is

$$\Phi_0(x, y) = \varphi_1 - \frac{4\pi}{\lambda} z_0(x, y). \quad (21)$$

The phase error term due to vibration is

$$\Phi_1(x, y, t) = -\frac{4\pi|A| \cos (\mathrm{wt}) + 4\pi \mathrm{Awt} \sin (\mathrm{wt})}{\lambda}. \quad (22)$$

The formula shows that for a specific laser wavelength, the sampling time, the vibration frequency, and the spatial distribution of the vibration amplitude when the sample to be tested is vibrating together affect the intensity of the interference fringe pattern.

The intensity distribution of the interferogram is

$$I(x, y) = |E_1|^2 + |E_2|^2 + 2|E_1||E_2| \frac{1}{\Delta t} \int_0^{\Delta t} [\cos \Phi_1 \cos \Phi_0 - \sin \Phi_1 \sin \Phi_0] \mathrm{d}t. \quad (23)$$

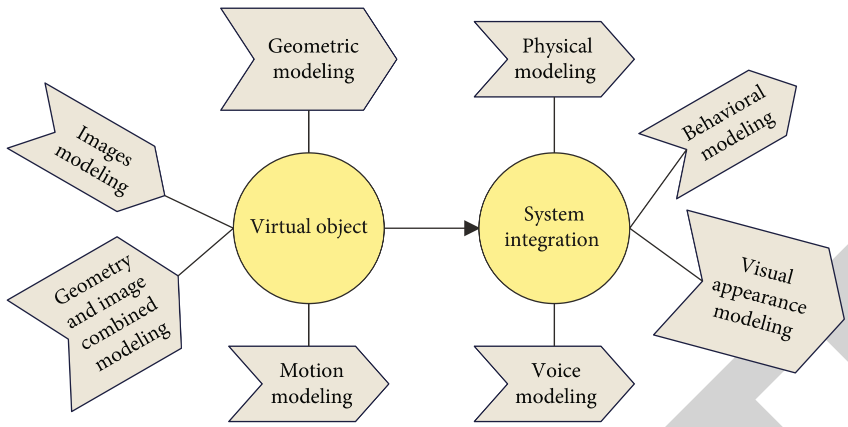

Figure 8: Classification of modeling methods.

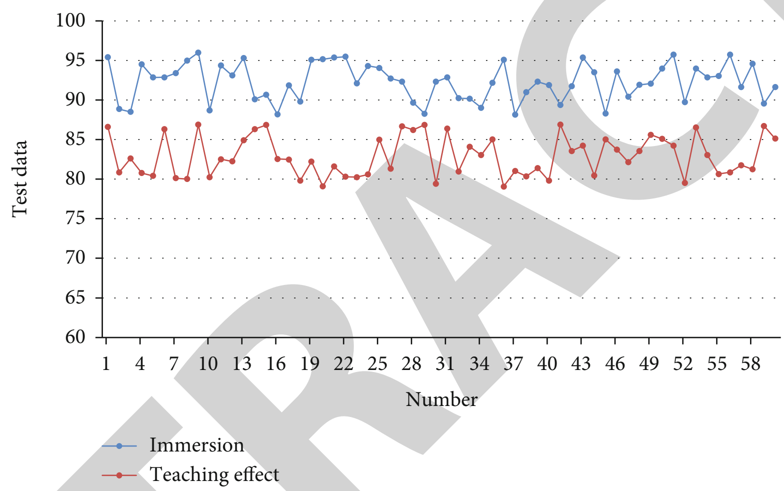

Figure 9: The application effect of immersive interactive technology in animation teaching.

The calculation of contrast needs to know the intensity extrema at the center of the bright fringes and the intensity extrema at the center of the dark fringes, which corresponds to the case of $\Phi_0 = 0, \pi, 2\pi, \cdots \cdots$. At this point, $\sin \Phi_0 = 0$. Among them, $\Phi_0 = 0, 2\pi, \cdots \cdots$ corresponds to the extreme value of the intensity of the bright fringe center. At this point, $\cos \Phi_0 = 1.\Phi_0 = \pi, 3\pi, \cdots \cdots$ corresponds to the intensity extrema at the center of the dark fringes. At this time, $\cos \Phi_0 = -1$. From this, it can be seen that the formula of the light intensity of the intensity extreme value $I_m(x, y)$ is

$$I_m(x, y) = |E_1|^2 + |E_2|^2 2|E_1||E_2| \frac{1}{\Delta t}\int_0^{\Delta t} [\cos \Phi_1]\mathrm{dt} \cos \Phi_0. \tag{24}$$

In the formula, $|E_1|^2 + |E_2|^2$ is the background light, and $2|E_1||E_2|1/\Delta t\int_0^{\Delta t}[\cos \Phi_1]\mathrm{dt}$ is the modulation term. When $|E_1| - |E_2|$, the formula reduces to

$$I_m(x, y, \Delta t) = 1 + M(x, y, \Delta t) \cos \Phi_0. \tag{25}$$

Among them, the modulation degree is $M(x, y, \Delta t) = 1/\Delta t\int_0^{\Delta t}[\cos \Phi_1]\mathrm{dt}$. When $\cos \Phi_0 = -1$, it corresponds to $I_{\max} = 1 + M$, and when $\cos \Phi_0 = -1$, it corresponds to $I_{\min} = 1 - M$. The contrast is

$$V = \frac{|\mathrm{I}_{\max} - \mathrm{I}_{\min}|}{|\mathrm{I}_{\max} + \mathrm{I}_{\min}|} = |M| = \left|\frac{1}{\Delta t}\int_0^{\Delta t} [\cos \Phi_1]\mathrm{dt}\right|. \tag{26}$$

The formula shows that in a certain vibration condition, the contrast changes with the sampling time.

(1) In a certain vibration situation, the sampling time is short and the vibration frequency is not large. At this time, the sampling time of the CCD camera is much smaller than the vibration period, that is, $w\Delta t < <1$. At this time, $-4\pi \mathrm{wt}|A| \sin(\mathrm{wt})/\lambda$ is smaller than $-4\pi|A| \cos(\mathrm{wt})/\lambda$ and can be ignored, and the phase error term caused by vibration is only $4\pi|A(x, y)| \cos(\mathrm{wt})/\lambda$. At this time, the intensity distribution of the animation ray image collected by the CCD camera is approximately

$$I(x,y) = |E_1|^2 + |E_2|^2 + 2|E_1||E_2| \cos\left[\Phi_0 - \frac{4\pi|A(x,y)|]}{\lambda}\right]. \quad (27)$$

The formula shows that when the sampling time is much smaller than the vibration period, the original vertical interference fringes will be distorted. Moreover, the size of the distortion is related to the distribution of the amplitude of the vibration. That is, the larger the amplitude, the more deviated from the original vertical state. At the same time, it can be seen from Formula (27) that the fringe contrast is mainly affected by the vibration amplitude.

(2) In a certain vibration situation, the sampling time is continuously increased. When $w\Delta t > >1$ is satisfied, the frequency shift caused by the Doppler effect can easily satisfy $\Delta f_D \Delta t > >1$. At this time, the interferogram changes from amplitude superposition to intensity superposition, and the contrast of the interferogram tends to 0

3. The Application of Immersive Interactive Technology in Animation Teaching

Virtual reality technology is a technology with a high degree of human-machine integration. The course system flow of animation major is shown in Figure 5:

In the "immersion mode" (as shown in Figure 6), the definition and positioning of the regression type are redone for teachers, students, and classrooms. In learning activities, the function of teachers is to organize, guide, control, and improve, and the task of students is to learn independently, think independently, share, discuss, practice, and innovate, and at the same time promote the continuous updating of teachers and learning activities.

In the new system, the setting and acceptance of these tasks will be presented in the online knowledge base, but for task completion monitoring and feedback, in addition to the established online mode, it will also be concentrated in offline classrooms. Because the classroom at this time is "liberated" from the basic knowledge points, the evaluation and promotion of tasks have become the main interactive content of the classroom. By completing each task, students achieve the balance between ability and task again and again, their ability has been improved in the task, and finally they have a sense of accomplishment. Teachers need to constantly adjust the matching of tasks and students' abilities through observation and evaluation in this process, so as to help students obtain the satisfying experience brought by task completion as much as possible, so as to complete the personalized learning experience process. Just like in the same single-player game, although the players' abilities, time, and other factors are different, as long as they want, they can finally complete the game and experience the satisfaction brought by the game.

In an immersive environment, students achieve autonomous knowledge learning. Teachers no longer carry out "cramming" teaching, but serve as leaders to help students enter knowledge learning. The relationship between teaching knowledge, teachers, and students is shown in Figure 7.

Modeling is the technique of virtual representation of real-world elements or objects, including static and dynamic element objects. Therefore, in the modeling process, it is necessary to analyze the static and dynamic features to obtain information on its appearance, shape, motion constraints, and physical properties. Thus, an immersive and realistic model is designed. In the virtual reality teaching system, common modeling methods are geometric modeling, image modeling, modeling combined with geometry and image, motion modeling, physical modeling, behavior modeling, visual appearance modeling, sound modeling, etc. Among them, the first four modeling methods are commonly used for the modeling of initial virtual objects, and the latter four modeling methods are commonly used for system integration, as shown in Figure 8.

After constructing the above model, this paper verifies the effect of the model and applies it to animation teaching. The immersive feeling and teaching effect of the system in this paper are verified, respectively, and the results shown in Figure 9 are finally obtained.

From the test results, it can be seen that the application effect of the immersive interactive technology proposed in this paper in animation teaching is relatively obvious.

4. Conclusion

Virtual reality technology integrates three-dimensional modeling technology, simulation technology, network technology, and other computer technologies to build a realistic visual, auditory, tactile, and other multisensory three-dimensional virtual environment. The virtual environment is very similar to the real environment, and the user completes the interaction and experience with the virtual environment and objects in a natural and harmonious way with the help of peripheral devices such as IoT devices and sensor devices. Moreover, the interactive, immersive, and conceptual characteristics of virtual reality technology make the immersive teaching system have three-dimensional visual effects and sound characteristics. Therefore, the natural and harmonious human-computer interaction is an important technical means of "thinking visualization" teaching. This paper applies immersive interactive technology to animation teaching to improve the effect of animation teaching in colleges and universities. From the test results, it can be seen that the application effect of the immersive interactive technology proposed in this paper in animation teaching is relatively obvious.

Data Availability

The labeled dataset used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare no competing interests.

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