Rendering of 3D CAD in Film and Television Special Effects of Group Animation

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Abstract. People constantly put forward new requirements for group animation simulation, the effect is more real, the number of groups is more, and it can respond to users' operations in real time to meet the interactive requirements. However, in the simulation of group animation, the technology of making animation role models is becoming more and more complex, and the degree of misfortunes among various models in the animation system is also increasing, which makes the creation of group animation more and more difficult. These requirements also bring challenges to the rendering process of 3D film animation. In this paper, the rendering of 3D CAD in group animation film and television special effects is studied. The engineering drawing design in 3D CAD system is not exactly the same as that in general 2D design system. The engineering drawing design in 3D CAD system can be directly projected from 3D model, thus ensuring the correctness of each view. Through 3D CAD, from the initial original painting and sub-shot design to the final post-production and synthesis, each production link is grouped and divided in detail, which can not only improve the efficiency of film special effects production, but also effectively guarantee the quality of films.

Keywords: 3D CAD; Group Animation; Film and Television Special Effect Rendering.
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1 INTRODUCTION

In recent years, group animation technology has been widely used in game creation, film animation, digital display, urban planning, training system, disaster scene simulation and auxiliary

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command and other fields. People constantly put forward new requirements for group animation simulation, with more real effects, more groups, and real-time response to user operations to meet interactive needs. However, in the group animation simulation, the production technology of animation character model is becoming more and more complex, and the confluence between various models of the animation system is also increasing, which makes the creation of group animation increasingly difficult. These requirements also bring challenges to the rendering process of 3D movie animation. The rendering system of group animation has also become the most critical constraint in the development of group animation. The amount of computation will increase rapidly and nonlinearly, which greatly affects the real-time performance of group animation and limits the wide application of this method.

With the strengthening of our government's attention to film and television animation, film and television animation related industries have also been developing rapidly, in which group animation industry is the most important. Therefore, this paper studies the rendering of 3D CAD in group animation film and television special effects. The engineering drawing design in 3D CAD system is different from that in general 2D design system. The engineering drawing design in 3D CAD system can be directly projected from the 3D model, thus ensuring the correctness of each view. In the practical application process of 3D CAD technology, it can also effectively cooperate with the film post-production software to improve the visual effect of the film. With the development of film special effects for many years, its application to 3D animation technology has become more and more mature, basically forming a complete special effects production system [1]. In the current computer games, the application of group animation is relatively small. The main reason is the complexity of group animation implementation, especially when the number of group members increases. In order to render group animation at an interactive frame rate and meet real-time requirements, large memory capacity, high speed, and the latest graphics hardware are required [2]. Therefore, on the premise of establishing the enterprise's own 3D CAD application system, the gradual transition to the 3D CAD application system is a necessary way to improve the group animation film and television special effects and improve their own design and development capabilities. In the process of applying 3D CAD technology, only designers can complete all operations through computers and related software, so this technology has been widely used in today's group animation film and television special effects [3]. In order to make the characters made in 3D look like they are in the same environment when they are finally combined into the film, we need to analyze the light environment, light source location, light source number and changes in temperature and temperature in the live shooting lens. Then, according to the analysis results, simulate the lighting environment of the live shot lens in the 3D software, so that the 3D characters can be more harmonious into the live shot film [4]. When the number of animated characters increases continuously, their computation will increase nonlinearly rapidly, which greatly affects the real-time performance of group animation and limits its wide application.

For the group animation film industry, 3D CAD technology, as the representative, promotes the continuous development of the film industry and gradually infiltrates into the field of life. The time that 3D film and television special effect technology experienced from its birth and development is basically similar to that of film. 3D special effect is an important branch of 3D animation technology. After receiving support from all sectors of society, 3D film and television animation has also become increasingly demanding. With the increase of clarity, the fidelity of character effects and the delicacy of scenes should be improved [5]. Finally, it will be rendered into various layered files through the renderer to prepare for post synthesis. Import the rendered image sequence frames into the post synthesis software, complete the color comparison and synthesis, and then output each file shot. In the production process of film special effects, each production link has been divided into groups and divisions in detail through 3D CAD from the initial original painting and shot design to the final post production and synthesis, which can not only improve the efficiency of film special effects production, but also form an effective guarantee for film quality.

The innovations of this paper are as follows:

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(1) The application of 3D CAD in group animation film and television special effects rendering is analyzed. With the improvement of living standards, people gradually pursue spiritual satisfaction. In recent years, in their spare time, people are more and more exposed to artworks, and the artistic quality of the masses is constantly improving, so they have different requirements for the details of rendered models. For example, in non-real-time applications such as film creation, the emphasis is on showing the delicate pictures of group animation. Therefore, in the process of rendering, it is necessary to choose a complete geometric model to represent the characters. For art, people gradually have their own evaluation criteria and preferences.

(2) Summarize the characteristics of 3D CAD in group animation creation. The emergence of movies, the real animation is developed after the emergence of movie cameras. In the process of development, animation has experienced a rather long process. The development of modern science and technology has injected new vitality into animation, and animation has developed into an art and a new industry.

(3) The research content of this paper is emphasized through simulation experiments. Through experimental analysis, it is found that 3D CAD virtual technology and virtual network are widely used. If people live in a virtual state for a long time, will people question their lives? The application of group animation film and television special effects rendering technology can make up for this. The development of 3D group animation in CAD has become an important trend in the development of computer industry. It is believed that in the next few years, 3D animation technology will be applied to various industries, and the rendering technology of group animation film and television special effects will inevitably be widely used in 3D CAD group animation.

2 RELATED WORK

With the continuous development of the film industry, the continuous development of the market and the continuous progress of computer technology, film, the eighth art, has added countless new contents and new creative techniques while retaining its original artistic essence. The most widely used field of group animation is that traditional modeling software configures actions after modeling, makes sequence diagrams, and combines them with film and television post production software to create group animation film and television special effects. This paper mainly analyzes the application of the special effect technology of group animation in animation production software from the technical level.

Animation film and television works produced by digital special effects can effectively improve the visual and auditory effects of the film and increase the artistic sense of the film. With the continuous improvement of science and technology, the application technology of digital special effects is also steadily improving. It has been used in many fields, including film and television animation. Xie [6] analyzes the application status of digital special effects and the application of digital special effects in film, television and animation production, and proposes to predict its development trend. CAD can use the keyboard or mouse to freely control the model and viewpoint orientation. Support the output of rendered models, which use 3D models. The independent rendering window supports model control. Xu and Wang [7] adopts the function of clicking directly on the screen, and can use the functions of snap, grip, attribute box editing, etc. Through computer animation, a series of scenery pictures are generated by means of graphics and image processing technology and programming or animation production software. People's creation of art is becoming more and more personalized, creating many representative works of art for people, meeting people's growing material and spiritual cultural needs. In this digital era, the emergence of digital media technology has brought great challenges and opportunities to art creation. The emergence of digital media technology makes people's communication more and more convenient. In order to better carry out artistic creation, we must have a neutral understanding of digital media technology. An important application of computer animation is to make special effects for movies. Computer animation plays an important role in the creation of virtual scenes, dynamic simulation, post-synthesis and other special effects. It has brought the creative level of the film industry to a new level and greatly affected the film market. Zhang [8] uses digital media technology for artistic

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creation. This paper analyzes the influence of digital media technology on art creation. The development of 3D animation special effects technology just provides strong technical and artistic support and assistance for film and television advertising. Zhang and Chen [9] adopts the performance limitations of the general film and television art, and gives full play to the imagination of designers and the expressive power of creative thinking. Clarify the application status of animation special effects technology in film and television advertising. The artistic expression of film and television advertisements has been enhanced through the rich expression techniques of 3D CAD, such as free lighting settings, arbitrary exaggerated deformation, rich material maps and special effects. When animation special effects technology is applied to film and television advertising, it can make film and television advertising more expressive. With the support of animation special effects technology, it can complete many scenes that can not be completed by live shooting or live shooting. Zhang [10] uses CAD in the rendering of group animation film and television special effects to make film and television advertising more expressive and competitive. It has greatly strengthened and enriched the multiple expressiveness of film and television advertisements in visual aspects.

3 ANALYSIS OF 3D CAD IN GROUP ANIMATION FILM AND TELEVISION SPECIAL EFFECTS

3.1 Overview and Characteristics of 3D CAD in Group Animation Creation

Animation is an art form suitable for all ages. On the surface, animation is a new art, but in fact, it has a long history. In ancient China, circus and shadow play were a traditional form of animation. In fact, groups are often composed of many similar characters, whose grid structure information is basically the same, but their performances are different, such as position, height, skin texture, animation and so on. In the process of group film production, the production of virtual props and scenes is not only the demand of film viewing effect, but also the basis of plot development and an essential element in film production. The emergence of movies, the real animation is developed after the emergence of movie cameras. In large-scale group animation scenes, rendering a large number of character models is a key factor affecting the performance of group rendering, so it is very important to optimize the rendering of a single character model. With the increasing number of characters being rendered, the optimization of single character rendering is accumulating, which will eventually improve the overall performance. In the process of development, animation has experienced a rather long process. The development of modern science and technology has injected new vitality into animation, and animation has developed into an art and a new industry.

In this paper, 3D CAD is applied to group animation creation. At present, it is difficult to recruit animation talents in the market, mainly because of two aspects: on the one hand, the education of 3D talents in China lags behind, and there is no high-quality supply; In addition, the creation of 3D CAD group animation also needs practical experience. In the current actual teaching process, similar disciplines are rarely involved. The direct result of this is the lack of "lens sense" and "visual language" when designing, binding and expressing roles. Through the application of 3D CAD technology, imaginary props and scenes can be made only by operating related software, without being limited by the real environment, so it is the best choice for group film making. This chapter puts forward an engine architecture of group animation, which mainly considers the behavior planning and rendering of group animation. As shown in Figure 1.

It is a good way to improve the speed by reusing grid data through instantiation, reducing the number of drawing calls and the demand for memory, leaving most of the rendering work to the GPU to complete, and reducing the CPU load. Dynamic level of detail is a compact model representation method, which does not have a hierarchical representation form. In the rendering process, a simplified model of related levels is automatically generated according to a certain criterion specified by the rendering algorithm.

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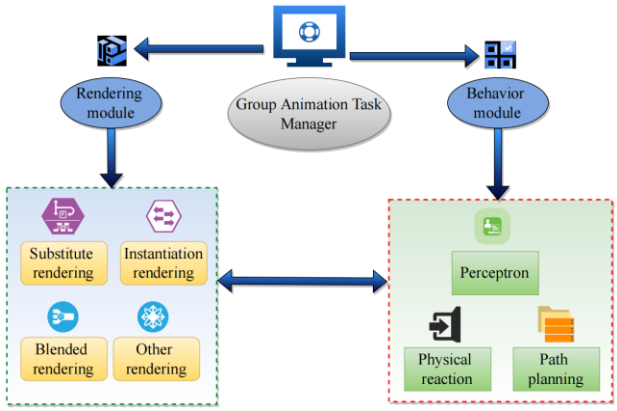

Figure 1: High-level structure diagram of group animation engine.

Based on the criteria of viewpoint, any number of triangular mesh models with different resolutions can be generated. Because the object represented is too angular and not similar to the shape of the fluid, of course, equal area is the first problem, followed by how to determine the focus of the ellipse. First, the area formula of the ellipse is $S=\pi ab$, where a is the length of the long semi axis and b is the length of the short semi axis. Let c be half of the focus of the ellipse, then according to the following equation:

$$S=\pi ab \tag{1}$$

$$a^2=b^2+c^2 \tag{2}$$

In the two equations, if S and c are known quantities, then the long and short half axes of the ellipse can be determined, and the equation of the ellipse can be obtained according to the focal coordinates.

Now for any vector $T=nN+t_1T_1+t_2T_2$ in 3D space. The normal curvature in this direction can be expressed as

$$k_p(T)=\begin{pmatrix} n & t \end{pmatrix}\begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & k_p^2 \end{pmatrix}\begin{pmatrix} n \\ t \end{pmatrix} \tag{3}$$

For the vector $T_0=\cos(\theta)T_1+\sin(\theta)T_2$ in the tangent plane, the normal curvature in this direction is

$$k_p(T_\theta)=k_p^1\cos^2+k_p^2\sin^2 \tag{4}$$

The following matrix is defined,

$$M_p=\frac{1}{2\pi}k_p(T_\theta) \tag{5}$$

The matrix is symmetric and can be decomposed as follows

$$M_p=T_{12}^t\begin{pmatrix} m_p^{11} & m_p^{12} \\ m_p^{21} & m_p^{22} \end{pmatrix} \tag{6}$$

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$m_p^{12} = m_p^{21} = 0$ easily calculated, and

$$m_p^{11} = T_1^t M_p T_1 \tag{7}$$

$$m_p^{22} = T_2^t M_p T_2 \tag{8}$$

3.2 The Application of 3D CAD in Special Effect Rendering of Group Animation

In order to render these slightly different characters, the traditional methods either store each character model separately, which consumes a lot of memory resources, or need to switch between rendering states frequently. In general, level details can be divided into static level details and dynamic level details. Static level of detail is a group of models with different complexity and similarity, and each model corresponds to a simplified triangular mesh model. The basic data flow in the group animation implementation process is shown in Figure 2. It can be seen that the vertex shader processes the updated instance data, character mesh vertex data, and skin animation related data in the texture, and then transfers the data to the pixel shader.

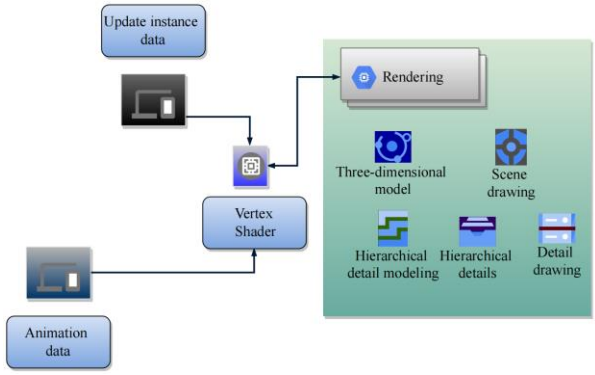

Figure 2: Data flow of group animation rendering.

⊖ Features and Advantages of Rendering Technology

All communications, whether creating, manipulating or deleting data, must be conducted through APIs. Therefore, all accesses to the core are completed through the member functions of each class. All Maya class names begin with an uppercase letter. The classes are also placed into subclasses based on function division, so as to distinguish them. As shown in Table 1.

Prefix	*Logical grouping*	*Example*
M	Maya class	MObject,MPoint
MIt	Iterative class	MItMeshEdge
MFn	Function set	MFnMesh

Table 1: Prefix of Class Name.

The design of class in Maya is different from the general object-oriented hierarchical design method. The difference lies in the fact that the general class combines data and functions for

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processing data into the class, while the Maya method separates the two. To make high-quality indoor renderings, it takes several hours to render, while when creating 3D animation, the animation must reach 24 frames/second to ensure the smooth picture. In this case, the animation made by a computer may only play for one second a day, and the animation takes a long time to make.

⊖ Setting of rendering attributes

In the application of rendering technology, all geometric objects, lights and cameras are defined by their rendering attributes. In real-time applications such as computer games, the emphasis is on the rendering speed, so the details of the representation can be selected according to the different positions of the characters on the screen, thus reducing the rendering time and ensuring the real-time performance of such applications. In each channel, create light and object partitions, and use shaders to jointly manage parameter settings. Sub-channel rendering effectively improves the rendering speed. Common special function and attribute settings are shown in Table 2.

Function	*Explain*
vg Fx Scale	Special effect size
vg Add Scene Fx/ vg Rem Scene Fx	Add special effects to/delete special effects from the scene
vg Fx Time	Special effect time
vg Fx Offset	Special effect offset

Table 2: Common special effects function.

At present, in 3D animation creation, common rendering attributes mainly include the following: ray depth, which mainly refers to the attributes of the material surface, such as object reflectivity, refractive index, etc. The rendering time will change with different data.

⊛ Different types of applications of rendering technology

Combine technology with other technologies, including substitute technology, to enhance the overall authenticity on the basis of maintaining the real-time and stability of group animation simulation. In the multithreaded rendering process, if the number of processors used is less than 8, it can effectively ensure the smooth rendering process. If the number exceeds 8, technicians should pay more attention to avoid problems in the rendering process.

However, on the whole, there are some defects and deficiencies in the application of 3D CAD group animation technology in China's film industry, which seriously hinder the further improvement of China's film production level. Estimating the Weingarten matrix at the vertex of the mesh First, we investigate the method of approximating with a sub-surface. Let Weingarten matrix be W , then the normal curvature of y_i in the direction is

$$k_{yi} = y_i^T W_{yi} \tag{9}$$

The approximate calculation is

$$k_{yi} = 2\frac{N \cdot (p - q_i)}{(p - q_i)} \tag{10}$$

Suppose the degree of the curvature vertex to be solved is n , then an equation system is formed

$$y_i^T W_{yi} = k_{yi}^{'} \tag{11}$$

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$$y_i^T W_{yi} = (u_i, v_i) = (u_i^2) \tag{12}$$

In this way, n equations form an equation group $Ux = d$, and x is calculated with the least square solution, thus W is obtained.

A system of equations can be obtained from points in a neighborhood

$$\left(\frac{1}{2}x_i^2 \quad x_i y_i\right)x = z_i \tag{13}$$

Next, consider fitting the local neighborhood with a sub-surface, that is, fitting the following equation

$$f(x, y) = \frac{A}{2}x^2 + Bxy \tag{14}$$

Its message matrix is the same as the previous text, and then combined with the normal formula

$$N(x, y) = (f_x(x, y)) \tag{15}$$

4 ANALYSIS AND DISCUSSION OF RESULTS

In this paper, the grid of group animation film and television special effects obtained by grid segmentation and merging method will not only have poor quality triangles in the merged area, but also have different shapes and sizes of triangles in different parts because of different grids. In order to make the final model have consistent graphics, on the basis of saving equipment purchase expenses, the rendering of group animation film and television special effects through 3D CAD is mainly based on the network, so there is no time and space restriction, and the utilization efficiency can be fully improved. The cloud computing rendering system also has an advanced rendering management platform, which can guarantee the finished product of the rendering mode to the greatest extent and reduce the technical difficulty. First, we resample the vertices of the grid of group animation film and television special effects, and then optimize the vertex flow. This step is the rendering step, which mainly generates relevant scenes or figures in the computer through the use of lights and complex operations in the computer. However, in the process of rendering, a large number of calculation steps are needed, and these calculation steps are the factors that affect the rendering effect. The mesh triangles obtained by this method are uniform in size. On this basis, this paper optimizes the vertex flow of group animation film and television special effects. Perform three optimizations respectively, as shown in Figure 3, Figure 4 and Figure 5.

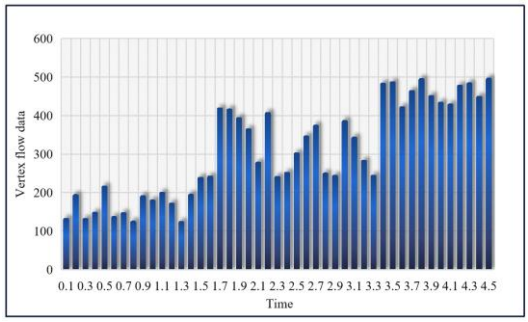

Figure 3: Optimization of the first fairing energy term.

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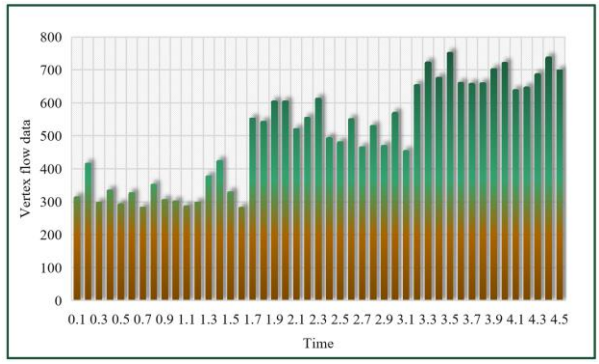

Figure 4: Optimization of the second fairing energy term.

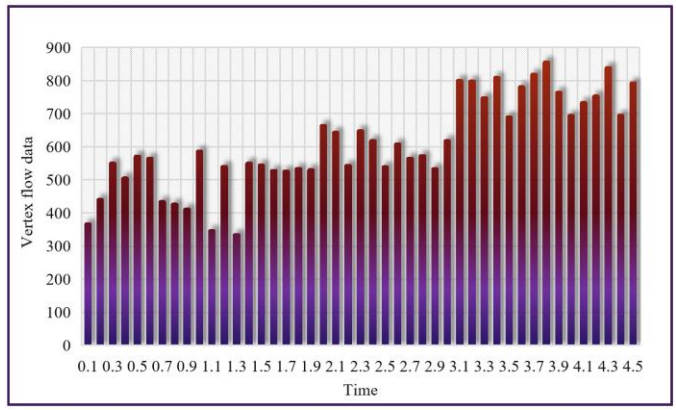

Figure 5: Optimization of the third fairing energy term.

Through the analysis of the above experimental results, it is obtained that each optimization example in the first optimization uses different fairing term weight values. The histogram value displayed in the second optimization is higher than that in the first optimization. Finally, the third optimization is the best among the three optimization. The results show that the results of group animation film and television special effects optimization can enhance the effect of line drawing. With the extensive application of 3D CAD virtual technology and virtual network, whether people will question their lives when they live in a virtual state for a long time can be remedied by the application of group animation, film and television special effect rendering technology. The development of 3D CAD group animation has become an important trend in the computer industry. It is believed that in the next few years, 3D animation technology will be applied to various industries, and group animation film and television special effect rendering technology will inevitably be widely used in 3D CAD group animation.

It can be seen from Table 3 that the efficiency of the two global optimization algorithms proposed in this paper is still high. Because the "sparsity degree" of the corresponding sparse matrix of the two optimization algorithms is different, the second method is denser, so the running time for models of the same size is also more.

Model	*Vertex number*	*Running time*

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Venus head	144252	18.00
Horses	18754	9.12
Bunny	41251	16.85
Rockerarm	4561	1.24

Table 3: Running schedule of global optimization algorithm.

View the display of group animation through the 3D CAD animation window, view the change of variables through the variable display window, and test the input curve and output curve. In the group animation window, we can see that each important parameter of the variable display window is constantly refreshed in real time, several state quantities have basically tended to be stable, and their values have better tracked the reference commands, as shown in Figure 6 ang Figure 7.

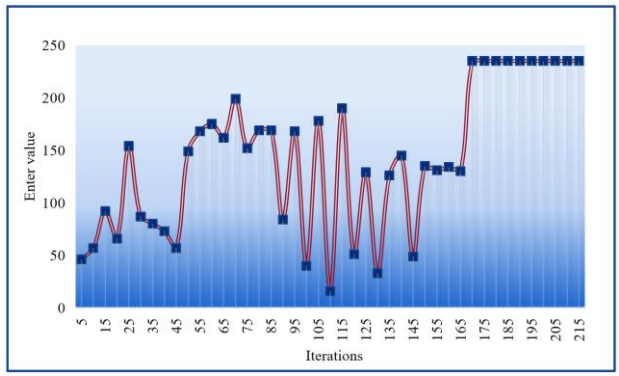

Figure 6: Partial parameter input curve.

Through the above experimental analysis, it can be seen that variable display can display the simulation data of group animation, film and television special effects in real time, but it is constantly changing, and it can't reflect the trend of data changes.

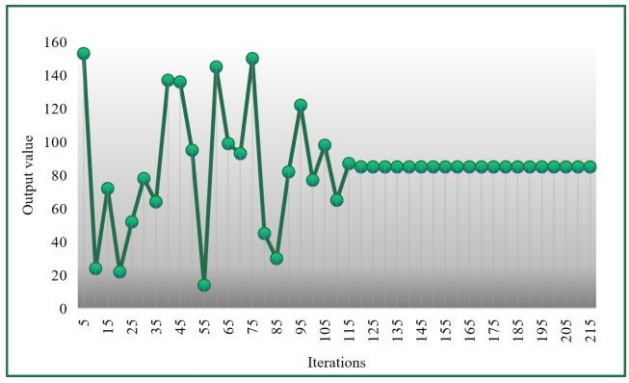

Figure 7: Partial parameter output curve.

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Therefore, the software has the functions of displaying some important parameter output curves and saving data. Group animation data preservation can save the values of some important parameters at each sampling point in the whole simulation process, which is convenient for data analysis after simulation.

5 CONCLUSIONS

This paper studies the relevant aspects of group animation film and television special effect rendering technology, and analyzes the group animation film and television special effect rendering through 3D CAD. After years of development, 3D CAD group animation changes with each passing day, leading people to a real world. The animation obtained in this way focuses the operation and generation process of each entity of the machine on the calculation part before displaying the animation, and directly uses the images after the operation and rendering of each entity of the machine to make the motion more coherent, the group animation effect better, and the animation speed is basically not affected by the computer performance. Through experimental analysis, it can be seen that although the simulation data of group animation film and television special effects can be displayed in real time, it is constantly changing and can not reflect the trend of data changes. Therefore, the software has set the function of displaying some important parameter output curves and data saving. Group animation data saving can store the values of some important parameters at each sampling point during the whole simulation process, which is convenient for data analysis after simulation. With the extensive application of 3D CAD virtual technology and virtual network, whether people will question their lives when they live in a virtual state for a long time can be remedied by the application of group animation, film and television special effect rendering technology. The development of 3D CAD group animation has become an important trend in the computer industry. It is believed that in the next few years, 3D CAD animation technology will be applied to various industries, and group animation film and television special effect rendering technology will inevitably be widely used in 3D CAD group animation.

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