Application Study of Virtual Simulation Technology Based on Lumion in Landscape Design

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Abstract. With the development of garden design to intelligent and efficient design, designers need a better way of expression. In order to meet the user needs and improve the simulation performance, this project adopts the Lumion drawing technology. Initial scene data were first collected to build a 3D model, and then imported into Lumion for preliminary mapping and vegetation layout. Finally, the image processing is refined to provide a richer and real scene experience and improve the simulation performance. This process uses SketchUp to create a landscape model and import Lumion. It, uses points, lines, planes and bodies to describe the virtual reality landscape structure, uses subpixel level offset to quickly form the scene, process materials and add design details. Virtual reality landscape visualization image is output after storage. The experimental results show that, compared with Sketch Upforvray and 3D StudioMax, this method uses less time and has better results, and is an efficient virtual reality landscape simulation design method.

Keywords: Virtual simulation; Lumion; landscape design; anti-aliasing design

1 Introduction

With the continuous development of digital media technology, the scene space expression of landscape design is becoming more and more convenient, and Lumion, developed by Act-3D in the Netherlands, is increasingly recognized by the market as a new real-time 3D visualization tool. Lumion The Quest 3d engine uses the DirectX technology of the display card to complete the real-time generation and rendering of scenes, and can save the images formed by the graphics card as high-quality pictures or animation, which involves the fields of architecture, planning landscape design and scene animation. Lumion Virtual simulation of software has the advantages of high production efficiency, clear output picture quality, and efficient production advantages can greatly save the time and energy of designers [1].

Lumion By building 3D models and integrating with other software models, various scenarios are quickly built. It uses game engines and real materials to generate images, and uses AIDS to enhance the visuals [2]. The software significantly improves the drawing efficiency, the computing speed of the graphics processor far exceeds the CPU, reduces the drawing time, and realizes the low-level drawing, making the ideal visual effect easier to achieve [3]. Lumion Also provide rich material library and prefabricated models, facilitate the garden design work, to achieve the completion of the whole project.

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2 Lumion principles of virtual simulation technology

2.1 Virtual scene simulation design process

Lumion In the early stage, it is attached to other diversified software. After sorting out and collecting the model data on the site, the word line graph and line diagram of the optimized landscape by the vector software AutoCad, and enter the modeling software after completion. After the model data is completed, Lumion is imported for scene configuration. Relying on the scene material library, landscape details are added for rendering to complete the whole simulation design process. The results are shown in Figure 1.

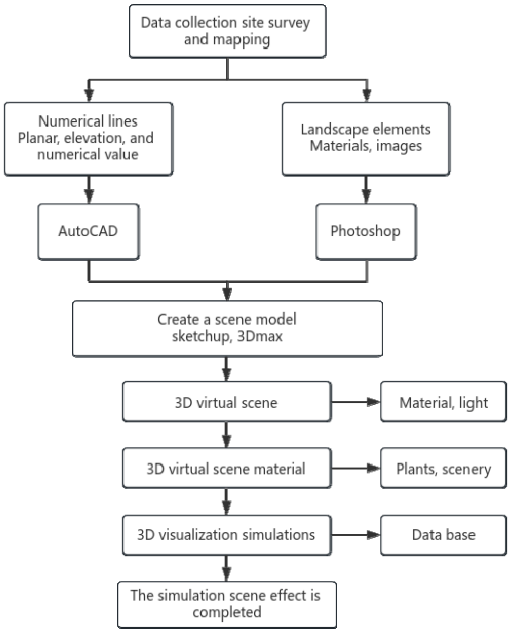

Figure 1. Lumion Landscape simulation design process

2.2 The design method of highly efficient drawing drawing

1)Preliminary rendering of the model: Lumion The super sampling technology of the display card can quickly render the rendering and reduce the serrated effect [4], but also the image generated by the graphics card can be saved as an image file or animation, real-time rendering and preset value fast simulation of the scene to produce real-time visual effect. The principle is to describe the main elements of the virtual reality landscape structure with points, lines, planes, and volumes [5]. Using the offset of the secondary pixel level, split one pixel into multiple when rendering, render one part of the secondary pixel each time, and finally synthesize multiple maps into a smooth result.

2)Quick anti-aliasing setting: Brightness images were synthesized by hypersampling antialiasing [6] created in separate buffer with higher resolution than the screen. Like screen 2 * 1, the buffer size is 4 * 2. Samples double pixels and select 2 or 4 adjacent pixels to generate

a final pixel with features of adjacent pixels. The human eye is able to smooth the color conversion, and the computer is output to the frame buffer [7], to form an analog image. Images are stored and sent to the display with full antialiasing. Landscape scene pictures all have anti-aliasing effect [8].

3)Optimization methods for light details: In the landscape simulation design of Lumion, sky visibility is the key [9] affecting the natural light realism of the scene. It analyzes the light-dark relationship of the image to accurately describe the illumination of the sky background. The scene atmosphere is an inseparable part. If there is no sky visibility, the object needs to calculate the light based on the CPU, which takes a long time. In virtual scenes, shadow relationships are important details. Setting soft shadows and fine detailed shadows can effectively improve the sense of reality and space of the object. Soft shadows form a hard shadow, achieving a natural soft and hard transition. Fine detail shadows are limited by the resolution of the shadow map, so small details cannot cast shadows, creating a "floating" effect. The screen depth data can be used, combined with the direct light direction to calculate the small radius occlusion relationship and restore the shadow of small objects.

3 Multiple experimental analysis based on different complexity scenarios

3.1 Experimental platform

In the process of the simulation experiment of the performance of the method in this paper, the test hardware accessories platform are: the system adopts Windows10 professional version 1809 version, the platform is the processor Ryzen R72700,8 core 16 thread frequency lock is 4.0 GHZ, the memory is zhi fantasy light halberd 16GDDR43000, the graphics card is shadow chi RTX2070.

3.2 Experiment content

The Sketch Upforvray, 3D Studio Max and this method are used to design a virtual reality simulation scene of a small architectural landscape, and the comparative analysis of rendering speed, picture processing performance, picture quality and other data, to prove the differences and advantages of the method studied in this process and other software simulation design [10].

In the above test platform, we used four parameters (objects, scene planes, object edges and decorative plants) in the main scene, complex scene, 2 times complex scene and 3 times complex scene to verify the accuracy of virtual scene simulation [11]. The experimental results show that the various algorithms have significant differences in the modeling number, operation difficulty, drawing time and drawing difficulty, which has a significant impact on the final rendering result. Detailed data are detailed in Table 1 and Table 2.

Table 1. Rendering environment parameters for different complexity scenes

Serial number	Name within the test scenario	Simple scene	Complex scene	Two times the complex scene	Three times the complex scene
1	Number of objects	71	156	312	468

2	Number of planes in the scene	22348	247632	495264	742896
3	Object side line	103404	1445044	2890088	4335132
4	Decorate vegetation / trees	6	60	120	180

Table 2. Performance differences of different simulation design methods

Method / function	Modeling operation difficulty	Render operation difficulty	Render animation function	A model library that can be called directly	Real-time rendering function
Methods used in this paper	Simple	Simple	Simple	Have	Have
3D Studio max virtual simulation	Complex	Complex	Complex	Not	Not
SketchUp forvray virtual simulation	Medium	Complex	Medium	Not	Not

3.3 Visual modeling error analysis

Visual modeling accuracy is the key to virtual landscape design. The smaller the error, the better the simulation effect. Experiments verify the three-method visualization modeling error. Six landscape A~F tests were used to calculate the visual modeling errors. See Figure 2-4.

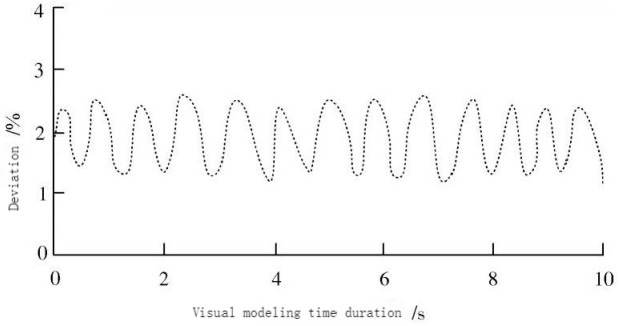

Figure 2. Visual modeling error curve of method proposed in this paper

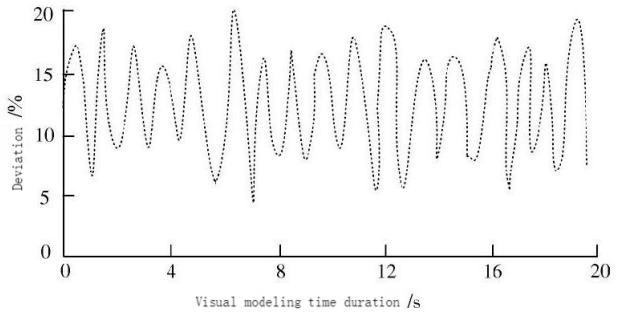

Figure 3. Visual modeling error curve of 3ds MAX virtual reality simulation design method

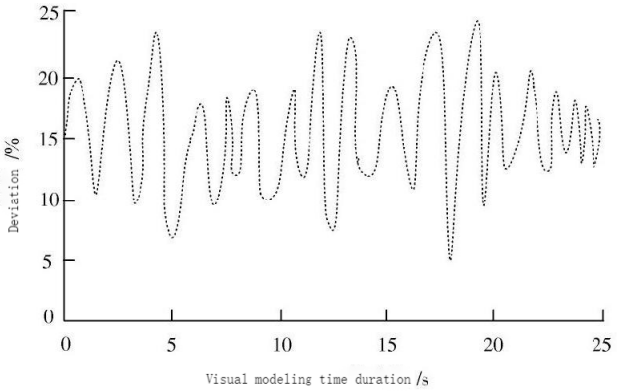

Figure 4. Visual modeling error curve of Sketchup virtual reality simulation design method

Comparing the modeling error curves of the above three methods, it can be seen that the modeling time of the method in this paper is only 10 seconds (here the modeling time integer is ignored, and the decimal point is ignored). The modeling error is between 1% and 3%. The error curve is small and uniform, and there is no significant peak. The method of constructing the visual model has small error and good stability. The modeling time of the 3ds MAX virtual reality simulation design method is about 20s. The error of the method is between 5% and 21% throughout the modeling process. The error fluctuations are larger than the proposed method, and there are 4 fluctuation valleys and peaks in the whole process. The sketch virtual reality simulation design method consumes 25s, is the longest of the three methods, the modeling error is large, in the fluctuation between 5% and 25%. It can be seen from the change trend of the error curve that this method has large fluctuation error and poor stability energy, which cannot be used for efficient and high-quality landscape visualization design. The method used in this study has the shortest visual modeling time and the best stability. Although the error is about 2%, it does not cause large interference to the later landscape simulation design, and has advantages compared with similar methods.

3.4 Scene rendering use-time difference analysis

In the process of simulation landscape design, the use frequency of batch rendering objects is very high [12], so the speed is also the key to affect the efficiency [13]. With the time consumed between 8.62 and 10.10 seconds, 3D max saves 725.13-759.91 seconds in the same scene, and 856.01-892.66 seconds compared with Sketchup rendering method. The results of the experimental data show that the method used in this paper has the advantage of fast efficiency. Based on the real-time rendering of the Quest 3d engine developed by Direct x, this method optimizes the files in advance, and makes the lighting design and anti-aliasing setting, which greatly improves the efficiency of scene file processing. As the scene complexity increases, the rendering distribution is smooth and uniform, and the duration curves for all scenes is at the bottom of the image, much lower than the other two methods. For example, the experimental rendering time of 3 complex scenes is controlled within 30 seconds, while the 3Dmax virtual reality simulation design method is contrary to this method. As the experiment unfolds, the presentation time of 3 complex scenes is 2082.31 seconds; the first increase during the test and then the growth rate of the third complex scene experiment is 1990.02 seconds.

3Dmax and Sketchup will increase the number of files in the test to a certain number due to object occlusion, slowing down the rendering time, as shown in Figure 5-8. In the modeling process, the higher the CPU frequency, the faster the processing speed, the modeling process is not easy to lag. In the modeling process, the higher the CPU frequency, the faster the processing speed, the modeling process is not easy to lag. With adaptive segmentation or Monte Carlo segmentation, all the refraction reflection in the rendering, the more lights, the longer the rendering time, so the longer the generation time.

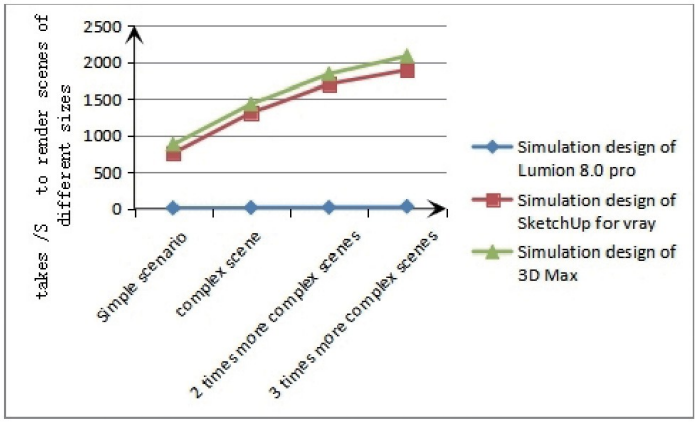

Figure 5. Comparative analysis of the first time data

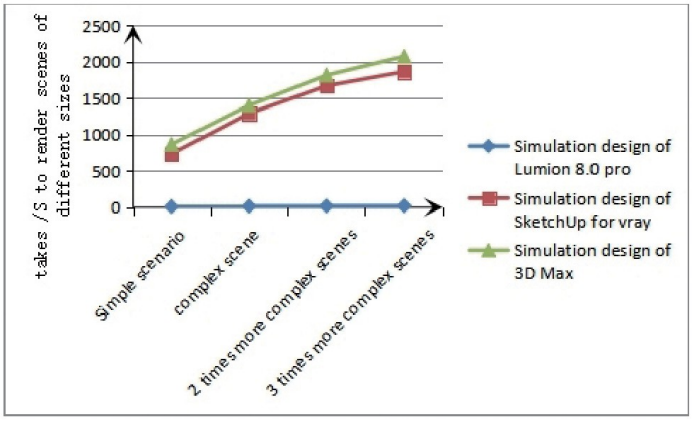

Figure 6. Comparative analysis of the second time data

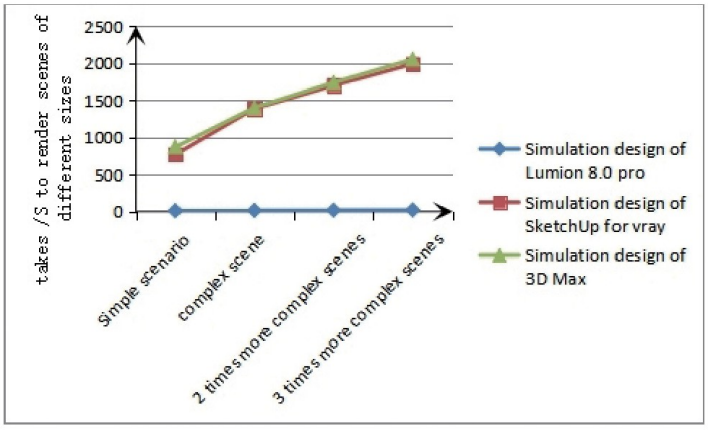

Figure 7. Comparative analysis of the third time data

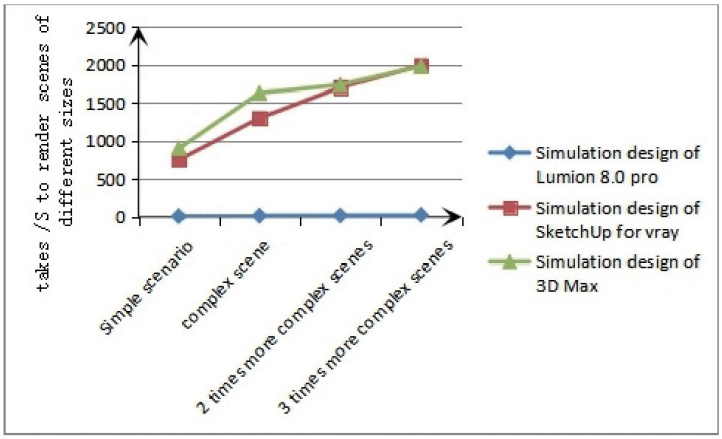

Figure 8. Comparative analysis of the fourth time data

3.5 Difference analysis of the scene rendering effect

According to the quality of the final drawing of Table 3, the method used in this paper is not only fast, but also has good light reflection and refraction effect of the scene, the building performance is real, and the landscape details are exquisite. Lumion The simulation technology of the display card produces real-time results, and the images generated by the graphics card can be saved as image files or animation. Through real-time rendering and preset value to quickly simulate the scene, using super sampling for picture segmentation greatly improves the accuracy of the picture, and achieves the real effect through the increase of various details. The simulation effect of 3D StudioMax production is slightly lower, but it needs to rely on Adobe Photoshop to make landscape plants, sky details and other effects, which brings complexity to the work. SketchUp for vray The effect in the space color performance is less than the first two kinds, the overall light is white, the lack of a sense of reality, the material is also single.

Table 3. Render the complex scene effect difference analysis table

Method / effect	The method used in this paper	3D max virtual simulation	SketchUp for vray Virtual simulation
Renderings clarity	High	High	High
Indoor light and shadow effect	Above-average	High	High
Outdoor light and shadow effects (large scene)	High	Medium	Medium
Natural degree of the model effect	High	High	Medium
Natural degree of the sky background	High	Low	Low
Model refinement	High	High	Low

4 Conclusions

This paper describes a simulation design and implementation of virtual reality landscape based on Lumion. The Lumion was imported by 3ds MAX modeling to optimize the landscape details using an irregular triangular network. GetValue With the VetValue program rendering landscape elements, batch rendering to improve efficiency. Lumion Two steps to achieve visualization: add the effect to enrich the visual effect of landscape objects, and meet the design standards. This paper expounds the working method of Lumion software as a powerful 3 D visualization tool, providing a new and effective 3 D visualization design method for environment, architecture and garden design fields. However, because the design of artificial lighting is not realistic enough, the optimized design of nighttime image lighting still needs to be improved. In the next stage, we will study it in this area.

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