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Influence of Digital Media Technology on Forest Scene Animation Design

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Abstract:

The animation construction of forest scene is a virtual stand scene visualization framework which uses the related technologies of virtual forest modeling and stand scene visualization, and uses the scene graph technology to manage. This paper studies the influence of digital media technology on the animation design of forest scene. In this paper, the model of virtual stand scene is mainly completed by Creator modeling software of MultiGen company. In order to reduce the number of scene patches and ensure realism, the tree model is designed with OpenFlight tree hierarchy. At the same time, the key technologies of Creator modeling and model optimization are analyzed. The virtual stand scene visualization framework uses the open source graphics rendering engine OpenSceneGraph (OSG) as the scene driver to realize the stand scene visualization. This paper provides a variety of roaming control methods. The experimental results show that the virtual forest scene visualization framework can better simulate the forest scene and has a strong sense of reality.

Keywords*:* *Forest Scene, Animation Construction, Forest Modeling, Stand Scene.*

I. INTRODUCTION

In recent 10 years, with the increasing attention to the growth mechanism of trees and vegetation and the simulation and prediction of forest ecosystem, the computer modeling and visualization technology with forest landscape as the main research object has become a research hotspot in the fields of ecology, forest management, physical geography, botany and so on [1-2]. Restricted by the development level of visualization technology, forest landscape visualization mostly uses regular geometry with small amount of data to express trees to simulate forest landscape, but this method has rough expression of plants and poor realism. With the development of software and hardware technology and visualization technology, scientific research institutions in various countries have launched relevant landscape visualization software [3].

Compared with foreign countries, the application degree of forestry scientific visualization

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technology in China is low, and the technical force is relatively weak. Since the 1990s, researchers in China have begun to study all aspects of plant landscape simulation. Forest landscape visualization is one of the core and basic technologies of forestry informatization [4-5]. At present, there are still some problems in the research of forest landscape visualization in both breadth and depth. For example, the process of forest growth and evolution cannot be dynamically simulated in three-dimensional scene, which is lack of interaction [6]. The forest growth modeling process is not based on the forestry survey database, which can not achieve the purpose of guiding forest production [7]. The simulation ability of forest structure is not strong, and the Stand Visualization Based on the restoration and reconstruction of forest spatial structure can not be realized. How to effectively apply forest landscape visualization in forest management practice is an urgent problem for forestry researchers.

II. SCENE GRAPH THEORY AND OSG RENDERING ENGINE

1.Theory and advantages of scene graph

Scene graph is a simple and effective data structure for organizing graphics and image data. It is a special directed acyclic graph. It saves the objects in the scene and their relationships. It is a k-ary tree structure [8]. The root node represents the whole scene. Each node in the tree can have any number of child nodes, and each node stores the data structure of scene integration. The scene graph usually contains three kinds of basic nodes: group nodes, geometry nodes and transformation nodes [9]. The group node can realize grouping management for all nodes; Geometry node is the description of the basic properties of an object, such as shape, size, color, etc. [10]. The transformation node is responsible for 3D geometric transformation, including translation, rotation, scaling, etc. Its organizational structure is shown in Figure 1.

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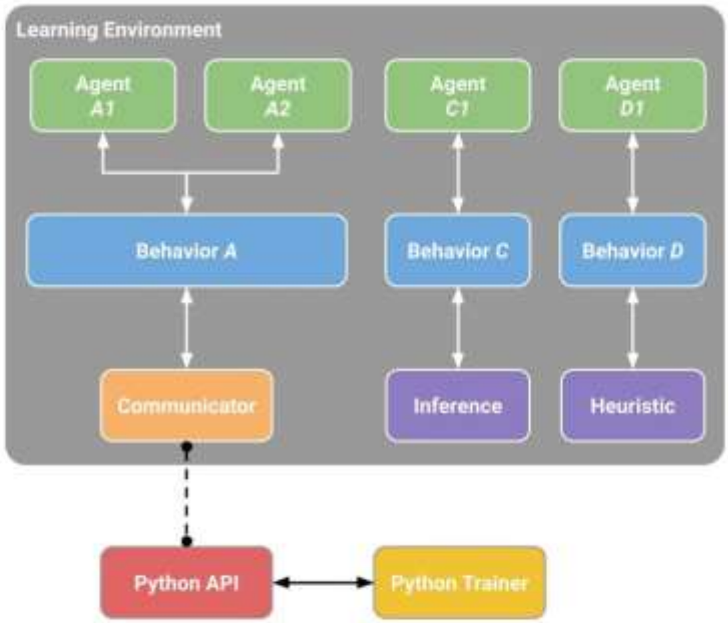

Fig 1: Scene diagram structure

Scene map technology is a popular way of scene organization in the world. It defines 3D scene as a series of continuous objects in space. Using scene map to manage 3D world has great advantages. The advantages of scenario map are as follows:

Spatial structure: the tree data structure used in the scene map is more intuitive and more in line with the arrangement and organization structure of spatial things in people's general understanding.

Scene picking: use the frustum culling and occlusionculling of the local CPU to reduce the overall burden of the system.

Level of detail (LOD): use the geometry bounding box to calculate the distance between the observer and the object, so that users can render objects at different levels of detail more efficiently. Moreover, those objects that enter the specified observation distance in the real-time scene will be loaded from disk, and once they exceed this distance, they will be removed from memory.

2. OSG rendering engine

OSG is a high-performance and open source visual simulation development kit based on OpenGL graphics function library and application program interface (API) of C + + platform. OSG is an open source, completely free, portable and high-level graphics toolbox. It is designed for high-performance graphics applications such as fighter simulation, games, virtual reality or scientific visualization. Add a complete set of function libraries that can quickly develop 3D

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graphics applications to provide object-oriented encapsulation mechanism, and developers do not need to implement and optimize the underlying graphics function calls. You can get rid of the complex underlying code and have more time to engage in specific function implementation and design. OSG contains a series of open source graphics libraries, which mainly provide the functions of scene management and graphics rendering optimization for the development of graphics and image applications. It uses portable ANSI standard C + +, standard template library (STL) and OpenGL underlying rendering API, so it has good cross platform characteristics. The OSG architecture is shown in Figure 2.

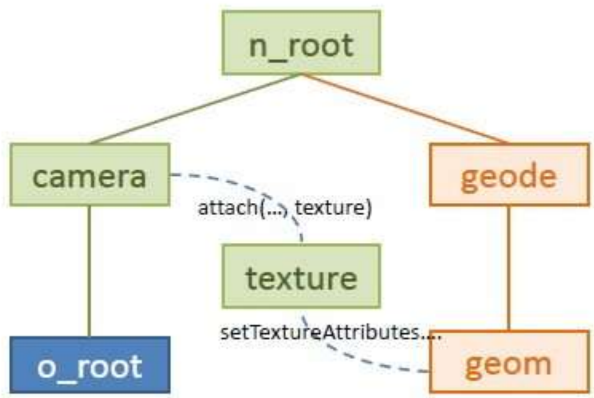

Fig 2: OSG architecture

III. STAND SCENE MODELING

1.Key technologies of modeling

Model is the template of prototype and the imitation and description of prototype. The quality of the model is the basic element to measure the visualization effect. In modeling, we usually follow the following requirements: first, the accuracy of the model. The accuracy of the model means that the model should accurately reflect the basic characteristics of the prototype. Second, the model should be brief. The brevity of the model means that when describing the basic characteristics of the prototype, the model should simplify the model, highlight its main parts, omit the secondary parts, and focus on reflecting the most essential characteristics of the prototype or the parts that people are most interested in.

Texture mapping is the process of mapping a two-dimensional image with color information to a three-dimensional object model and forming the object screen drawing area after perspective transformation. Two dimensional texture is defined on a plane region, which can be expressed analytically by mathematical functions, or discretely defined by various digital images. In this way, a gray value or color value is defined at each point on the plane region. We

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call the plane region texture space. In graphics rendering, the application of texture mapping method can easily determine the corresponding position P (u, v) of any visible point on the scene surface in the texture space, and the texture value or color value defined at P (u, v) describes a certain texture attribute of the scene surface at point P. The texture attributes mentioned here include various parameters related to lighting model and surface geometry, such as surface normal vector, diffuse reflection coefficient and so on.

When multiple objects with the same geometry but different orientation or size are involved in the scene, if these exactly the same models are transferred into memory, it is bound to cause great waste. At this time, the instantiation method can be used. That is, only one instance of the same object is stored in memory and used as a reference. Other identical objects can be regarded as a link of the reference model. These identical objects can be established by translating and rotating the reference model. This greatly reduces the number of polygons required, saves memory, speeds up the display speed, and saves the workload of modeling.

2.Terrain model modeling method based on Creator

At present, the commonly used topographic elevation data include DEM data of the U.S. Geological Survey (USGS), DTED data of the U.S. Bureau of image and map (NIMA) and data from some other sources. Terrain data in these formats cannot be directly rendered and output in OSG, and data preprocessing must be carried out. Using ERDAS image and gloal mapper software, the scanned grid image and other existing images are geographically corrected to make them register with each other and unified into a standard geographic coordinate system to form a geographic grid image. In terrain conversion, we should consider selecting different map projection and reference ellipsoid. Map projection is the theory and method of transforming any point on the earth's surface to the map plane by using certain mathematical rules. The selection principle of projection method is to minimize the distortion of the generated terrain. Table 1 lists five common projection methods:

TABLE I. Common projection methods

PROJECTION MODE	CHARACTERISTIC	SCOPE OF APPLICATION
TRAPEZOIDAL	Trapezoidal projection, an azimuth projection. The projection center point is the most accurate. With the increase of offset distance, the error increases accordingly. It is suitable for terrain database with small target area.	Terrain within 1 degree (longitude) and X1 degree (latitude)

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UTM	Transverse Mercator coordinate projection. The terrain along the meridian direction is accurate: the farther the ion meridian is, the greater the distortion is.	An area that is long in the north-south direction or along the meridian
GEOCENTRIC	A circular earth projection in which the Z direction points from the center of the earth to the north pole of the earth.	Large terrain or simulated earth surface curvature is required
LAMBERT CONIC CONFORMAL	Lambert cone orthographic projection. The region seen in high latitude flight is very accurate. The more towards the poles, the more obvious the deformation is.	There are two standard parallel boundary areas
FLAT EARTH	Take the latitude and longitude as X and Y coordinates to generate rectangular terrain data.	An area that is long from east to west and away from the poles

When choosing the map projection method, we should also choose different reference ellipsoid models. The earth's surface can be approximated as an ellipsoid geometric model. It is usually determined by two half axes: long half axis A and short half axis B, or by one half axis and flatness. Where, the oblateness a represents the flattening degree of the ellipsoid. The calculation formula of flatness is: α= (a-b) / a. The basic elements a,b,α of these earth ellipsoids. There are many kinds of parameter values of the earth ellipsoid because of the different ages, methods and areas of determination. Commonly used ellipsoid models include Bessel, Clarke 1866, WGS-72 and WGS-84.

3.Scene optimization technology

In order to achieve the balance between scene realism and real-time, the scene model must be optimized appropriately. Its main purpose is to improve the real-time performance of the system scene, reduce the number of polygons drawn by the system and improve the frame rate of graphics drawing without significantly affecting the visual effect. Based on terrain modeling and scene entity modeling, stand visualization technology was studied in detail.

Rendering a large amount of forest scene in real time is a big challenge for forest scene visualization, because a large number of trees need to be rendered in the forest scene. If each tree is completely modeled, each tree will contain a large amount of geometric data. Without any simplification of these geometric data, even modern high-performance graphics cards can not render the forest scene in real time. Now a variety of technologies have been developed to face this problem, in which level of detail technology has been widely used. Level of detail (LOD) technology refers to using a group of entity level of detail models with different complexity (generally measured by the number of polygons) to describe the same object, and switching in these detail models according to the distance of viewpoints or other standards in

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graphics rendering, so as to change the complexity of the scene in real time.

All 3D models created by creator are composed of patches. Deleting patches that are invisible from any viewpoint for patch merging is the most direct way to reduce the amount of model data. These patches can be details inside the model, faces obscured by other objects, or the bottom of the model. For example, when modeling the tree model, the bottom surface of the tree rod and crown, the connection surface between them, etc.

In the process of forest scene rendering, the external control is only limited to the keyboard and mouse, so more functions cannot be reasonably arranged, such as various parameter settings. Because the stand visualization framework has many interactive functions, graphical user interface MFC is selected for management. In the framework interactive interface, the OSG program for forest scene rendering is mainly controlled through the MFC menu. In the forest roaming scene, OSG provides some mouse and keyboard controls by default in order to easily and quickly browse the forest scene in all directions and angles. As shown in Table 2.

TABLE II. OSG default keyboard function

KEYBOARD KEYS	OPERATION
Space	Reset camera position
Esc	Exit operator
f	Full screen / window switching
s	Display frame rate and other information
w	Switch polygon, line and point display modes
z	Start recording camera path
o	Save the scene map of the current scene to a file
b	Switch back removal
l	Switch light
t	Switch texture

IV. CONCLUSION

Forest landscape visualization needs to solve two major problems: one is the realization of three-dimensional modeling of trees, and the other is the three-dimensional reproduction of forest landscape. The former should solve the three-dimensional shape of trees, and the latter should truly reproduce the global environment of stand visualization. Based on the existing stand scene visualization technology, this paper proposes a stand visualization framework based on scene map technology management, which has achieved good results in the experimental process. A stand scene visualization framework based on scene map management is proposed. Each scene and its attributes are organized through the scene tree. The root node in the scene tree represents the simulated whole stand scene, simulates the terrain and different stand sets through child nodes, and uses leaf nodes to describe the characteristics of terrain or stand. The experimental results show that the stand visualization framework based on scene map technology management can facilitate object reuse, draw stand scenes effectively and quickly, and improve the interoperability of client programs. In terms of stand landscape visualization, the research intensity and depth in China obviously lag behind the international advanced level. Therefore, it is urgent to strengthen the research on forest landscape visualization technology. Forestry informatization will become a development trend in the 21st century, so that it can be applied more widely and more conveniently to serve people's life.

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