THE FACTURE OF SURFACE TEXTURE
BASED ON THE MAP DATA

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Abstract: In the practice of using the technology of virtual reality to carry out the terrain environment simulation, the effect of simulation lie on the detail of DEM and verisimilitude of the texture. But the more detail of the DEM, the more triangle face in the model and the more data to participate in the real-time interaction and calculation. So the speed of the terrain's real-time display will de slowed down. An effective way to solve the problem is simplifying the DEM and using the realistic surface texture to describe the detail of the terrain and to distinguish the geographic elements . So the preparation of the surface texture is a pivotal tache during setting up the virtual terrain. The surface texture can be obtained either by directly using the orthograph of remote sensing (or space photography) or by using the map. This paper mostly expatiates on the ideal and the facture of the realistic surface texture which based on the map data.

Ⅰ Introduction

Map is the base and record of space cognition. In this sense, it should be a development of map's function by using the technology of virtual reality to carry out the terrain environment simulation. In the past, beside some personal experiences such as traveling, exploration, prospect and so on, maps and reference materials (such as writing records) were the general way for people to cognize the environment. Personal

experience is confined by the field of vision, and reading maps and materials is lack of sense of reality, so as complement, sand table and three-dimensional map are expected of approaching reality. However, readers are bystanders all along when they observe environment. They can not be personally on the scene. "Virtual Reality"(VR for short) technique provides a new way for people to cognize the environment. Readers make participators personally on the scene, but not bystanders any longer. Using VR technique in the terrain environment simulation can show geographical landscape and achieve or approach the result of field exploring.

However, it must satisfy two conditions at least to achieve the result of terrain simulation by using VR technique: one is that readers should be personally on the scene, that is to say achieving the result of stereoscopic vision and stereophony. Another is that readers should control freely the route of entering terrain environment, that is to say carrying out the real-time interaction in displaying the terrain. To satisfy the first condition, we need some stereo display and stereo observation equipments. While for the second condition, not only the hardware should be superior, but also the application software should be optimized, especially for the complex form and structure like terrain. The terrain will be more precise and more realistic, if the DEM have more details. Nevertheless, because of constraint of hardware, real-time displaying the DEM that has lots of data is impossible. If we simplify the DEM, the details of terrain will be lost and it looks not realistic and vivid enough. An effective way to solve the contradiction between the speed and the effect of the terrain's real-time display is using the delicate surface texture full of details to remedy the details lost by simple DEM. In addition, surface texture can show other surface feature (such as planimetric feature) beside terrain, and develop the sense of reality of virtual terrain. Therefore, the preparation of the surface texture is an important tache during setting up the virtual terrain. This paper expatiates on how to get the surface texture and a facture of surface texture based on the vector map data.

Ⅱ Methods on how to get surface textures

Surface texture can be divided into two kinds: real image and unreal image.

Real image can be obtained by aerophotography, which is to get Orthographic image. This kind of image can be directly used as texture sticking on the surface of the model (Figure 1). This texture is got by shooting the real thing, so it has strong sense of reality. Nevertheless, since this image is only a mechanical reflection of the surface, and there exists lots of uncertain information and noise, if is difficult for non-professional personnel to decide the needed elements exactly. And to gain this kind of image requires the support of the aviation and space technology, of which data source is rather expensive. So sometimes it can not meet the wider demands.

Unreal image can be gained through scanning the map or using the vector map data. Direct use of scanning the map can also be regarded as the surface texture of the topography model, but its vision effects are not good and can't show the surface vividly and realistically (Figure 2). The surface texture derived from the vector map data can simulate the terrain and surface feature, and therefore make them have both accuracy and lifelike visual effects.
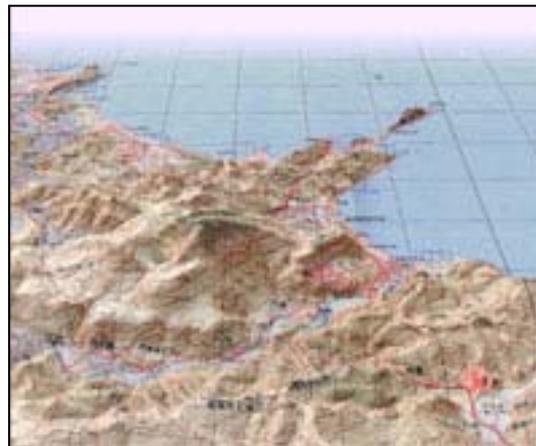
Figure 1   Figure 2

There are two types of emulational surface texture (Figure 3) based on vector map data.

1、Symbolized Landscape and Planimetric Feature Texture.

Among the many things in the surface, some are small-figured but significant planimetric features (e.g. Architectural complexes. Roads and control points .etc). No concrete details but a general outline can be seen from the high space. For this reason,

these surface elements' textures are able to use traditional map symbols to produce symbolized surface texture. This form also emphasizes small-figured but meaningful planimetric feature and is easy to cognize.

2、Simulated Landscape and Planimetric Feature Texture.

Besides small-figured but meaningful planimetry mentioned above, there are some other elements having important effects on the surface appearance, such as

Figure 3

vegetation, soil texture, water area, and these elements are full of bumps and holes simulate the texture of this kind of feature can be realized in two ways.

（1）Making use of the image processing means now available to produce

At present, there are many image processing software in the market, among which Photoshop is the most famous. It has strong function, and quite lifelike surface texture can bi made by way of its strong function of filter effects. This method is mainly introduced in this paper.

（2）Made automatically by Applying Algorithm

There are altogether two types of it: 1. Set up texture models through abstraction the Features of the real image texture, that is to say, test the Texture Element (a combination of one or more picture elements which forms the Texture) by texture analysis, get information about the array and distribution of texture elements, then build up texture characteristics models. Practically, relevant texture pictures (e.g. Relevant vegetation texture picture) can be made according to the models. 2. Produced by using mathematics algorithm. For instance, make use of disturbance algorithm, make subtle disturbance to every sampling position to change the surface's microcosmic geometry shapes, so as to cause the disturbance of the thing's surface normal vectors. Because surface's brightness is the normal vector's function, it is sure that disturbance of normal vector mentioned above may result in the sudden change of the brightness, thus produce

the real effects in which the surface is full if bumps and holes. The texture made in this way is also called scraggy texture. At present, what is commonly used is to produce changes of the colors' light and shade in the image through fractal algorithm, consequently create the surface's irregular scraggy effects, which is also named color texture. What textures this article describes belong to color texture.

Ⅲ **A Method of Creating Surface Texture Based on Vector-map Data**

The method of creating surface texture based on vector map data in this paper depends on two basal softwares. One is "Map data maintenance platform" (Mapviewer), specially used to process vector-map data. The other is commercial image processing software Photoshop. It is a very popular software in image processing trade , its functions and traits are not given here . We only describe correlative operations linking up with the course of creating surface texture. And it is necessary to introduce some correlative functions of " Map data maintenance platform" software here.

Mapviewer is a software developed by the Cartology and GIS Department of the Serving and Mapping University especially for Three-dimensional landscape simulation. Its functions include data format conversion, terrain modeling, two-dimensional electronic map design, data provision of three-dimensional landscape texture, effect preview of three-dimensional landscape, etc. According to the graph of vector- map, the module of data provision of three-dimensional landscape texture can gain element images used for creating surface texture. These images are basal materials for creating landscape texture, after being processed by Photoshop, they would be compounded into a realistic surface texture image. The creating flowline is showed in the Figure 4:

1. Creating Terrain Background Texture

Base map of terrain is the basic of whole surface texture. All kinds of surface feature are on a background of the base map of terrain. And the creating of a base map of terrain is on the base of DEM. Using Mapviewer can establish DEM and Orthographic projection landscape with illumination effect under the northwest light source. The orthographic projection image can be used as terrain background texture.

The key to creat background texture is the design of color gradients. In order that

background texture has realistic three-dimensional effect, three points must be grasped in color gradients of landscape:
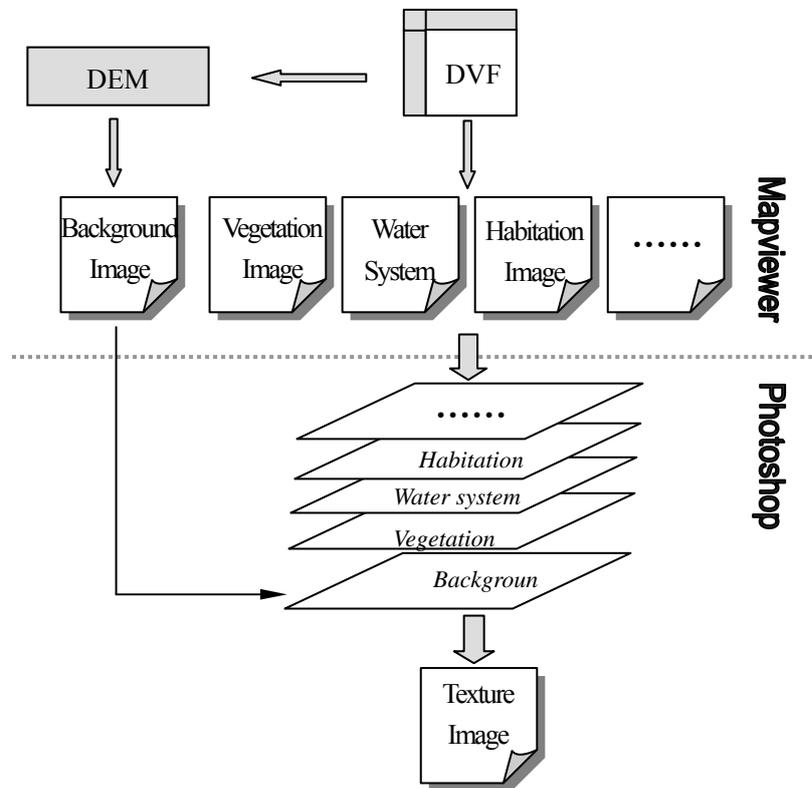

Figure 4

(1) Color gradients can't collide with the illumination. The shadow traits of the massifs being shined sideways are: the higher and steeper the sunlit slopes are, the lighter the lamp-house are; and the steeper the apheliotropic lopes are, the darker the lamp-house are. So the color layer table should adopt the design proposal—the higher the lighter.

(2) The earth surface is intact. Tint of color layers should keep it continuous. So leap and abruptness between color layers should not be too obvious.

(3) Color of layers should be chosen close to the nature color of the earth surface. And the nature color system is nearly related to physiognomy types and geographic

area.

Based upon above rules, linked to different physiognomy types , tint rules of a color index can be summed up as follows:

Plain and swale terrain—The coverage area of vegetation in plain is great . Considering nature characters, its color should be inclined to cyan and green. Because of plainness and wideness, its color layers' width and colored area are comparatively big, and its color stimulus is comparatively strong also, too bright colors, such as kelly, shouldn't be adopted in the area. Green system with mezzo lightness and low saturation is fit for plain area, such as grass green, aqua, celadon, caesious color, etc. In plain area, color layers may have changes, usually the higher the terrain is,the more light-colored and warmer the color is. In swale area under sea level, its color is often more saturated than the color of plain area and more inclined to cold tone, such as bottle green, turquoise, etc.

Hilly terrain—Hills, with slightly undulate terrain, are transition zone between plains and mountains. Its tint should select the lowly saturated transitional color system of chartreuse—laurelyellow—laurel—green—light brown.

Mountain terrain—Because of the big span of mountain altitude, its tint needs many series of gradual transi-tional color layers. Usually it adopts fulvous color system. The massifs are embodied by the transition of chartreuse-laurel-yellow-orange clear-flat reddish brown-brown.

2. Creating Vegetation Texture

Vegetation texture is comparatively important in surface texture. Its realistic degree has great influence on final texture effect. Firstly, according to vector-map data, an image of vegetation distribution range can be gained with Mapviewer (Figure 5-a). Then the image may be processed by Photoshop. And the visual effect of seeing overland vegetation from the sky will be simulated. The material way is as follows:

(1) The edges of vegetation area can get spatter torn effect with the filter function "Torn edges" in Photoshop, and simulate the uneven effect of the edges of vegetation coverage area.

(2) The vegetation coverage area can be added up noises with the function of

"Grain filter" in Photoshop. Select sprinkles in types, adjust intensity parameter to represent density of vegetation distribution. (Figure 5-b)

(3) Select vegetation area and paste it on the corresponding terrain background image. You can find now that the two images are not syncretized together, third dimension of massifs is not represented yet. If transforming the transparency of vegetation layer, you'll find vegetation and massifs syncretized very well.

(4) Have the vegetation layer processed further with emboss and represent extrude effect. (Figure 5-c)
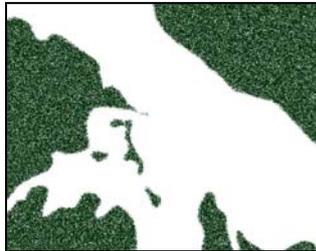

| Figure 5-a | Figure 5-b | Figure 5-c |

3. Creating Water system texture

There are two ways to represent water system on land. One is type of line, such as river; the other is type of area, such as sea and lake. For texture of line –typed water system, you may use map symbol graph directly and process it with concave effect only. For big area-typed water system, you can process it with ripple, do as follows:

Set the foreground color of Photoshop toolbox lighter blue and background navy blue. Make a baffling effect of sea's color with the clouds filter, then make a ripple effect of sea with detail ripple filter and sea ripple filter.

4 . Creating texture of other elements

Besides above ones, there are some other elements on earth surface, such as habitation, roadway, etc. These elements' texture can be represented directly by map symbol. They can also be processed with protruding and concave effect for lifelikeness. (Figure 6)

The method of creating surface texture introduced above is fit for representing

landscape of small scale, There is other method for creating texture of visual scale landscape. Because the texture created in this way is based on vector map data, its exactness and realities are higher, and some elements texture can also be represented for special need. Above, we simply introduce basic thought and method of creating surface texture. However, free exertion space of designing and creating texture is very large. So every one can create texture needed with his imagination according to likeness.

Figure 6

Ⅳ Concluding Remarks

The quality of surface texture affects the sense of reality of virtual terrain and the accuracy of description direct only. The advantage of aforementioned method is the terrain's location is accurate because the surface texture is based on vector map data. But this method asks persons who make the surface texture have art accomplishment in a certain extent. No matter in the color design of color layer table or in the treatment of texture color, it reflects a person's aesthetic judgment. According prefabricate texture bank, we can not only promote efficiency of making texture, but also reduce the dependence on person's accomplishment. This is our next objective.

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