AI Implementation of Freehand Ink Dynamic Modeling and Rendering Algorithm

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Abstract. Freehand brushwork is the quintessence of Chinese culture and a business card of Chinese culture in the international cultural market. However, domestic games seldom use freehand brushwork style to make real-time dynamic rendering of game pictures. The basic reason is that the picture structure of freehand brushwork is complex, there are many elements, and the terminal computing power and rendering cycle cannot achieve more than 30 frames of game pictures per second Dyeing effect. Through the analysis of this paper, through simplifying the model and optimizing the rendering logic, we can realize the dynamic rendering of freehand ink painting style animation.

Keywords: AI Implementation, Freehand Ink Dynamic, Rendering Algorithm

1. Introduction
Rendering is the last process of CG and the stage of making your image match your 3D scene. In English, it is called render, and some call it shading, but generally shade is called shading, and render is called rendering. Because render and shade are two different concepts in 3D software. Although their functions are very similar, they are different. Shade is a display scheme, which usually appears in the main window of 3D software. It plays an auxiliary role in observing the model as well as the wireframe of 3D model. Obviously, shading mode is easier for us to understand the structure of the model than wireframe mode, but it is just a simple display, which is called shading in digital image. In advanced 3D software such as Maya, you can also use shade to display simple light effects, shadow effects and surface texture effects [1]. Of course, high-quality shading effects need to be supported by professional 3D graphics display card, which can accelerate and optimize the display of 3D graphics. However, no matter how optimized, it can't turn the displayed 3D graphics into high-quality images. This is because shade adopts a real-time display technology. Due to the speed limitation of hardware, it can't feedback the ray tracing effects such as reflection and refraction in the scene in real time. In the real work, we often output the model or scene as image file, video signal or film film, which must go through the render program [2].

Freehand brush work is a simple way to describe scenery. Freehand brushwork is mostly painted on
the life propaganda, with vertical brushwork and ink color flying. Compared with Meticulous Brushwork, freehand brushwork is more able to reflect the verve of the scenery and express the author's feelings directly. It is expressed in terms of center front, flank front and counter front. Freehand painting is gradually formed in the long-term art practice. Among them, the participation of literati in painting has played a positive role in the formation and development of freehand painting. It is said that Wang Wei of Tang Dynasty was famous for his excellent poetry and painting, so later people called his painting "poetry in painting, painting in poetry" [3]. He "changed the method of hook" and created the ink breaking landscape with "light ink and clear brushwork". Xu Xi of the Five Dynasties first used ink to write the branches, leaves, pistils and calyx of flowers, and then slightly applied light color to create the "ink dropping method" of Xu style.

2. Difficulties in Freehand Ink Rendering

In the past, the physical engine, particle engine and light engine are often used to render freehand ink animation, and the final rendering is performed under complex particle components. It often takes several hours or even longer for a single workstation to render a frame. But under the demand of real-time dynamic rendering of games and other applications, the frame rate is required to reach more than 30 frames per second on general mobile terminals [4]. At this time, it is impossible to use the traditional way for logical planning. As Figure 1.

![Figure 1. Rendering Algorithm](image)

This paper analyzes the painting style of freehand brushwork, and adopts the techniques of glue ink, water ink, dry pen, etc., to make the picture rich in layers and varied in color. It is necessary to cooperate with the vivid blank to realize the picture of aesthetic Chinese style. In the past, in order to achieve the effect of freehand ink, we need to model and render the ink drops one by one, which consumes a lot of computing resources. If the ink block rendering method is adopted, the multi-point perspective principle of ink painting is analyzed, and the components are set as ink block controls with transparency and noise map, the calculation amount of rendering can be effectively reduced, and high-speed real-time dynamic rendering can be realized.

For example, in the traditional mode, there are about 4000-6000 ink drops in a ribbon, rendering time is about 6000-9000 seconds (100-150 minutes) per frame one by one, and the ribbon is planned as the whole ink block, and the bone technology is used to attach it, driving the single ink block rendering of the model with the heterochromatic transparent material, the actual rendering speed will be less than 1 second. With buffer technology, it can achieve real-time rendering of more than 30 frames per second.

3. Rendering software logic of freehand ink

First, the number of components should be greatly reduced. Make full use of the mapping material to
realize the display of details. Taking the streamer as an example, movie level rendering will implement each texture detail with components. At this time, a large number of components will be formed, and each component will be mapped independently, with independent optical, particle and physical calculation. Rendering will achieve a long time. When texture materials are used to represent its details, on the one hand, the structure of components will be simplified to the greatest extent, on the other hand, the number of components will be greatly reduced. Compress its rendering time thousands of times.

Secondly, make full use of the render buffer algorithm. After the initial rendering of the components, most of the engine configuration parameters are saved in the buffer, so it is not necessary to calculate the engine parameters frame by frame, but also can greatly reduce the calculation work of the front engine parameters in the rendering process, so that the rendering time can be reduced by 10 times to 100 times.

If the freehand ink effect is displayed in real-time dynamic rendering, the key technology is the transparency and hierarchy of components. At this time, it can be realized by simply adjusting the transparency of color blocks. In the fixed component rendering parameter configuration, this kind of rendering time is far less than the independent rendering of complex component groups.

Thirdly, the concept of multithreading management is adopted to make full use of the thread resources of multi-core processors. In the movie level freehand ink rendering process, GPU floating-point computing power is generally used as the main rendering computing resource, but for real-time dynamic rendering devices such as home computers, mobile phones, tablets, etc., the CPU floating-point computing power is far less than GPU. But its multi-core computing resources can provide software logic with sufficient independent thread resources. For example, in the 8-core CPU, one core is used to run the game engine, one core is used to calculate the rendering parameters under different rendering engines, and the other six cores are used to render images according to the gradient, so the actual rendering efficiency can be increased by 6 times. Even if a core cannot complete rendering within the design time, it can realize frame skipping processing. At the game experience speed of 30 frames, the frame skipping of 1-2 frames is inserted, which is not within the visible range of the naked eye, and the game's card feeling will not affect the game experience too much.

4. Summary

Through the analysis of this paper, taking Qualcomm 8 core chip as an example, it is feasible to use mobile terminal to realize dynamic rendering of game animation with approximate freehand ink effect at more than 30 frames per second. Although the final rendering image can not reach the level of movie level animation, it can realize the mobile terminal dynamic rendering technology application of freehand ink style animation game. This is of positive significance to the promotion of Chinese freehand ink culture. The game art style similar to freehand ink can be realized through large color block, low precision modeling, high precision mapping material and transparency control.

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