A Research on 3D Texture Production Using Artificial Intelligence Softwear

Ke Ma, Jeanhun Chung*

*Doctor's Course, Dept. of Multimedia, Graduate School of Digital Image and Contents
Dongguk University, Korea
*Professor, Dept. of Multimedia, Graduate School of Digital Image and Contents
Dongguk University, Korea
a1044894679@gmail.com, * evengates@gmail.com*

Abstract

AI image generation technology has become a popular research direction in the field of AI, which is widely used in the field of digital art and conceptual design, and can also be used in the process of 3D texture mapping. This paper introduces the production process of 3D texture mapping using AI image technology, and discusses whether it can be used as a new way of 3D texture mapping to enrich the 3D texture mapping production process. Two AI deep learning models, Stable Diffusion and Midjourney, were combined to generate high-quality AI textures. Finally, the lmage to material function of substance 3D Sampler was used to convert the AI-generated textures into PBR 3D texture maps. And applied in 3D environment. This study shows that 3D texture maps generated by AI image generation technology can be used in 3D environment, which not only has short production time and high production efficiency, but also has rich changes in map styles, which can be quickly adjusted and modified according to the design scheme. However, some AI texture maps need to be manually modified before they can be used. With the continuous development of AI technology, there will be great potential for further development and innovation of AI-generated image technology in the 3D content production process in the future.

1. Introduction

1.1 Research Background

Ai-generated image technology began to gradually become popular in 2022, and the two AI deep learning models of Stable Diffusion and Midjourney were studied and used by more and more practitioners, and were widely used in advertising packaging design, game and animation concept design and music and other fields. Since AI image generation technology is mostly applied in the field of graphic design, the application and development of AI image generation technology in the field of 3D image production is also a relatively new field, therefore, there is still a large space for the development of AI image generation technology in the field of 3D image production. This paper aims to explore the application value of AI-generated image technologyin 3D texture mapping production by introducing the application cases of AI-generated image technology in 3D texture mapping production

1.2 Research Purpose

The purpose of this study is to study the application cases of AI-generated image technology in the field of 3D texture mapping production, analyze the production mode and artistic characteristics of adding AI in the process of 3D texture mapping production, and summarize the advantages and existing problems compared with traditional 3D texture mapping creation. This study aims to explore and analyze the application feasibility and possibility of AI in the field of 3D image design by studying the application cases of 3D texture mapping generated by AI-generated image technology.

2. Theoretical Background

2.1 AI Generates Image Algorithm

Stable diffusion and Midjourney is a text-to-image model based on the latent diffusion model (LDM). By transforming human language into machine understandable mathematical vectors and then combining it with semantic vectors, it gradually removes noise from pure noise to generate hidden variables of picture information, and finally transforms the hidden variables of picture information into real pictures.

Both Midjourney and stable diffusion are deep learning-based AI-generated models that automatically generate excellent images. As the two most popular and outstanding AI drawing tools currently available, both tools have advantages and disadvantages. Although Midjourney is a closed-source AI tool, it only needs to input simple prompt words to generate high-quality AI images, but it cannot flexibly adjust the images. Although the effect of stable diffusion is not as good as that of Midjourney and the operation process is more complicated, it has complete functions and can flexibly adjust various attributes of the image.

2.2 3D Texture Map

In the process of 3D image production, texture mapping is a key link. Texture mapping is a simple method to map pixels in the texture space to the surface of the 3D object, and wrap the image around the 3D object. It can be combined with lighting calculation, image mixing and other technologies to increase the realism of the 3D object and make it more realistic to the photo. In recent decades, many more complex mapping types have emerged, such as bump mapping, normal mapping, displacement mapping, reflection mapping, specular reflection mapping, and variations of this technique.

3. The Practical Application of AI in 3D Texture Production Process

This study is based on the Midjourney and stable diffusion deep learning algorithms in AI, combining the two algorithms and the lmage to materialfunction in Substance 3D Sampler to generate 3D texture maps that conform to the PBR rendering process, introducing a new method of 3D texture mapping, analysing and researching the application cases of 3D texture mapping generated by the AI image generation technology, and exploring the applicability and possibilities of the application of AI in the field of 3D image design.

3.1 Midjourney and Stable Diffusion

3.1.1 Midjourney Generate Base Tile Maps

According to the design requirements, we initially input simple cue words and attribute suffixes in Midjourney to obtain high-quality AI images. As shown in Figure 1, the prompt word "Exquisite peony embroidery, delicate and intricate silver stitching" is entered into the Discord platform, and after the prompt word, the attribute suffixes are added to increase the quality of the image: "8K", and to create a tiled seamless texture. The image quality of the pattern tiling AI image can be obtained by entering the prompt "Exquisite peony embroidery, delicate and intricate silver stitching" in the Discord platform and adding the attribute suffix to increase the quality of the image after the prompt: "8K" and "tile" to create a tiled seamless mapping texture, and then selecting a texture that meets the design requirements from the four textures generated to proceed to the next step in the design process.
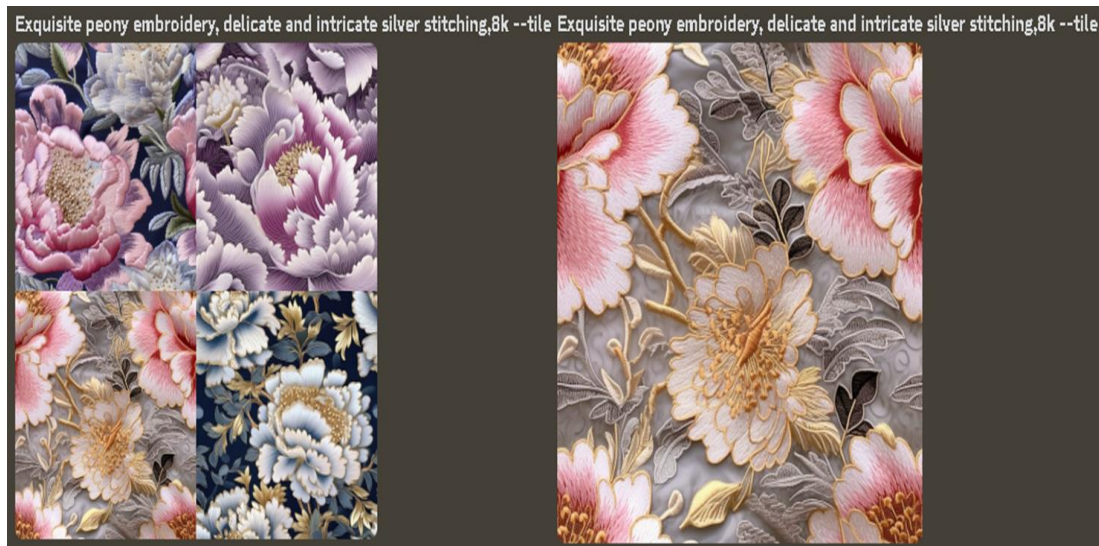

Figure 1. Midjourney Image Generation Process

3.1.2 Stable Diffusion Magnification Mapping

Due to the low resolution of the AI image generated in Midjourney, which is only 1024x1024 pixels, many of the texture details are not clear after scaling, so you need to use the zoom function in Stable Diffusion to zoom in on the texture image and enhance its texture details. There are four steps to use Stable Diffusion's AI image magnification function, and the order of use is as follows:

1. As shown in Figure 2 in Stable Diffusion enter the relevant prompt words "best quality, ultra-high resolution, (photorealisticel.4.)), delicate peony embroidery, delicate and intricate silver thread stitching, delicate embroidery" and the negative cue word "extra fingers, fewer fingers"..
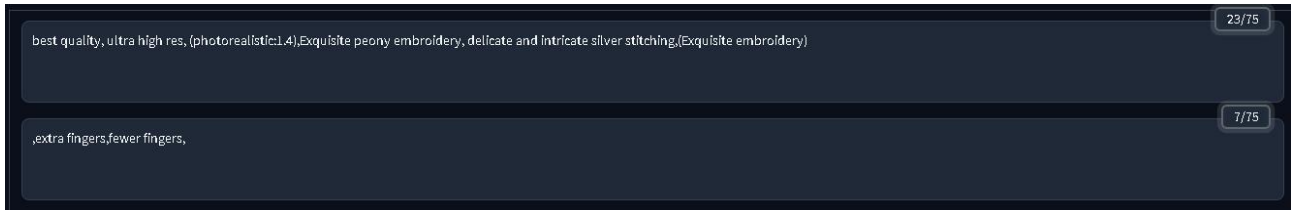

Figure 2. Stable Diffusion Prompt

2. As shown in Figure 3, the size related parameters need to be adjusted by selecting Crop and resize in Resize mode. When this option is selected, only size related attributes will be adjusted; DPM++ SDE Karras was selected as the Sampling method, and the images generated by this sampler were more stable. The base width and Height sizes in Resize to are resized to 1024 resolution, making it easy to enlarge the image with subsequent plugins. Finally, the Denoising strength is changed to 0, because the larger the value of this parameter, the larger the gap between the final result and the original image.
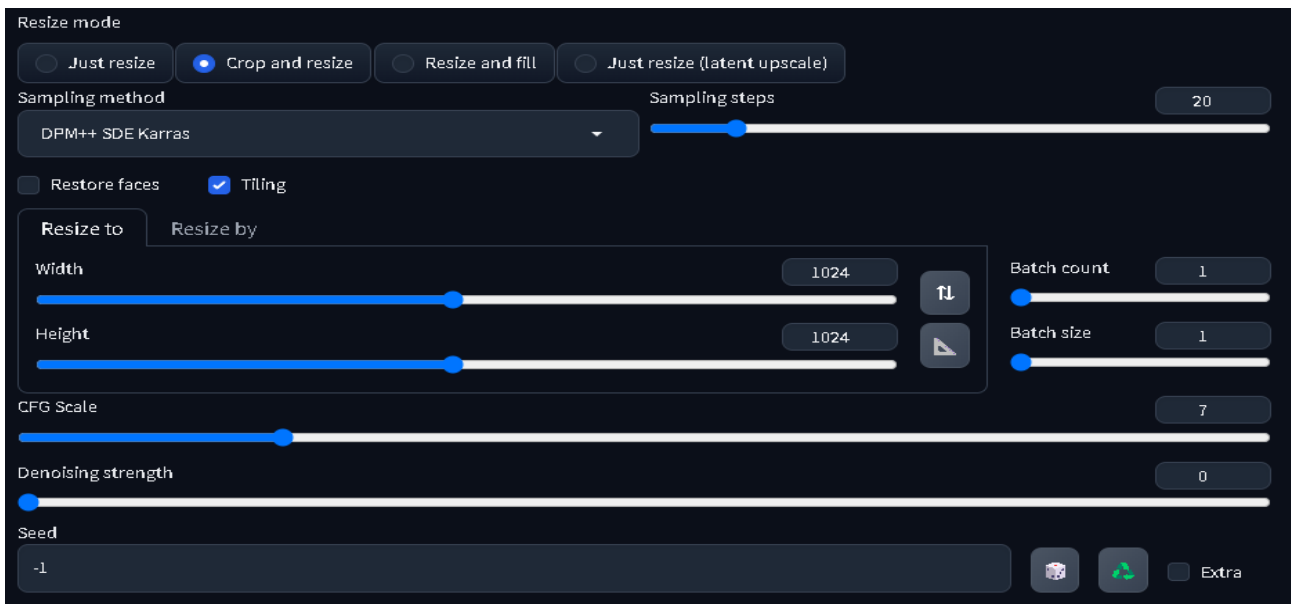

Figure 3. Stable Diffusion Adjustment of Basic Parameters

3. As shown in Figure 4, after the above parameters have been adjusted, you need to use the Tiled Diffusion function in Stable Diffusion, Tiled Diffusion is an amplification plug-in in Stable Diffusion, this function can help users to zoom in to the ideal parameters of the low-resolution image without loss. Only need to tick a few options, you can get the ideal image enlargement results, first, select Enable to enable Tiled Diffusion plug-in, and then select ESRGAN_4x enlargement algorithm in the Upscaler, this algorithm has good enlargement effect and consumes less display memory, and then the Scale Factor parameter can be adjusted to adjust the resolution of the image, default value The next Scale Factor parameter can adjust the image resolution, the default value of 2, the value of each enhancement of 1 point, the final image resolution doubled, the figure of the parameter is 4, that is, 1024x1024 resolution enlarged to 4096x4096 resolution; Finally, the use of the Tiled

VAE function, can be calculated in chunks of the image to reduce the pressure on the graphics card memory, to prevent the configuration of the algorithm is too low to stop the operation automatically.

Figure 4. Tiled Diffusion and Tiled VAE

3.2 Substance 3D Sampler Generates PBR Maps

As shown in Figure 5, the 4096x4096 resolution image obtained from the above steps is imported into Substance 3D Sampler, and its lmage to material (Al Powered) function is used to convert the base colour texture mapping to standard PBR texture mapping.
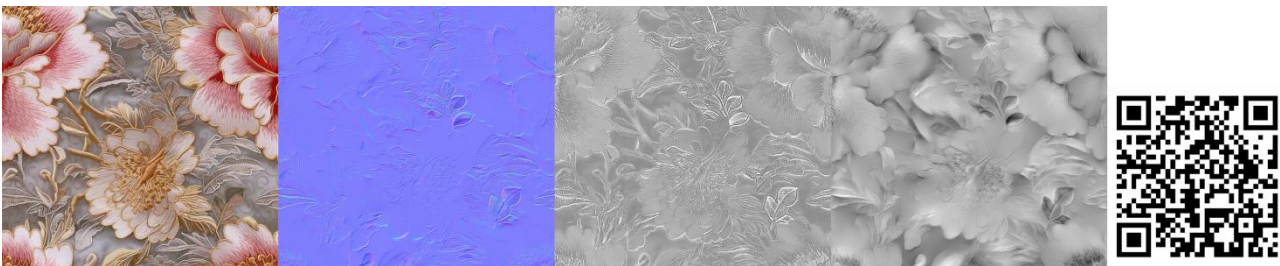

Figure 5. Generated PBR Texture Maps

3.3 Case Applications

Through the above production method, I use this method as the basis for the design of three sets of AI texture maps for different 3D objects, in Unreal Engine were applied to 3D indoor environment in 3D wallpaper, tablecloths, beds, and other 3D objects, and with no use of the process of production of texture maps for observation and comparison.

As shown in Figure 6, for the 3D indoor environment, covered in the chair on the curtain and tablecloth display effect, the left for the use of AI produced by the texture mapping effect, the right for the use of AI did not produce the texture mapping effect, the left side of the curtain effect compared to the right side of the curtain is more brightly coloured, the pattern is richer.

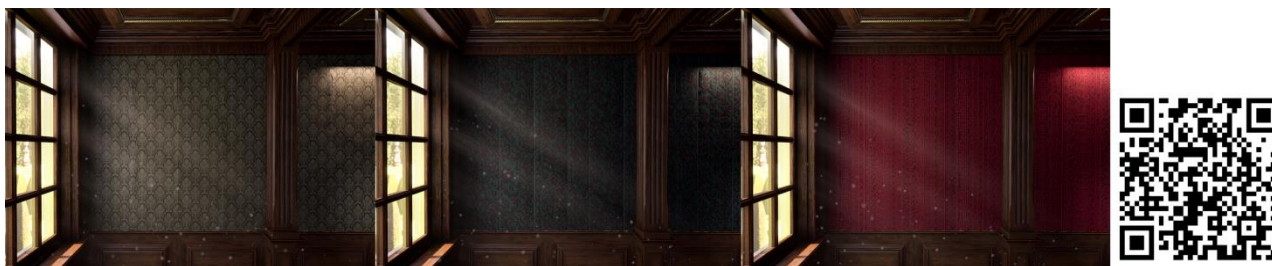**Figure 6. Comparison of Texture Effect**

Figure 7. Wall Effect Comparison

As shown in Figure 7, the artistic expression effect of AI material mapping on the wall. The leftmost picture shows the effect of texture mapping without AI, and the two effects on the right are the effects of material mapping quickly generated by AI. From the perspective of artistic expression effects, 3D materials made by AI have richer texture effects, and various artistic styles are more expandable.

4. Conclusion

Through this study, we explore the possibility of applying AI-generated image technology in 3D texture mapping production and identify its important value in 3D texture mapping production. The process of combining AI generation techniques with 3D content creation is a growing area of research where there is much to learn and explore. Through the application process and cases of this paper, the production efficiency of AI-generated texture maps is improved, and multiple sets of different styles of texture maps can be generated, and quickly converted into PBR 3D maps to meet different design requirements. In spite of this, AI-generated map textures also have some shortcomings. Although the generated map styles are many and have a wide range of choices, they cannot be accurately modified. In addition, some texture maps need to be manually processed again in other software to meet specific design requirements, so further improvement is needed to meet different design requirements. In conclusion, AI-generated image technology has great potential in the 3D content production pipeline, and we hope that this initial exploration will pave the way for future 3D content design research, enabling 3D digital art creators to continue to push the boundaries of what is possible in the field of artistic expression, providing designers with more efficient production efficiency and more creative design inspiration.

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