

# ACCELERATION CHIMERA HOLOGRAM RENDERING WITH UNREAL ENGINE

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**Abstract.** *The integration of holographic technology has revolutionized various industries, offering immersive and interactive experiences. CHIMERA is the third generation of a digital holographic printing system based on three low-power continuous lasers combined with Ultimate U04 silver-halide holographic glass plates. The research delves into the theoretical foundations of holography and the specific requirements for generating holographic content. This paper explores the efficient creation of content for CHIMERA holograms using Unreal Engine, a widely acclaimed game development platform known for its versatility in constructing dynamic holographic scenes. We compare 3ds Max with Unreal Engine, employing a comprehensive analysis that includes the generation of multi-view images. The juxtaposition of these two powerful tools aims to provide a thorough examination of their capabilities in terms of rendering and visual content creation.*

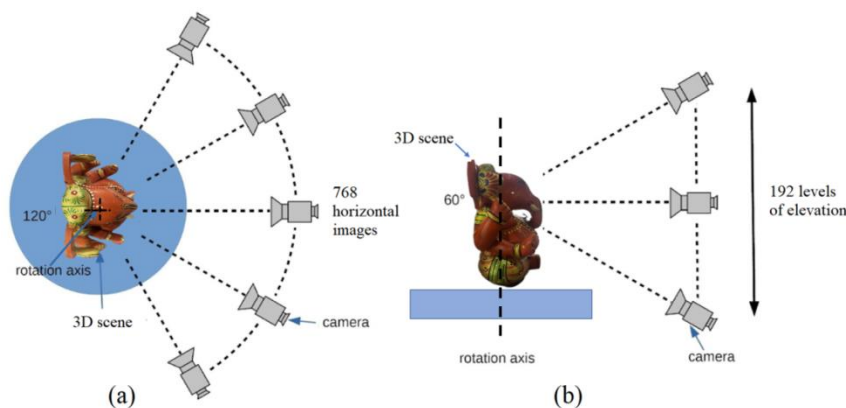
**Keywords:** *Digital hologram, CHIMERA, silver-halide, Unreal Engine.*

## INTRODUCTION

In the realm of visualization studies, the generation of holographic projections has emerged as a recent and captivating topic, offering a novel approach to interpreting complex medical images and engineering data. The quest for comprehensive visualizations often encounters challenges rooted in the demands of high computer configurations and specialized optics-barriers that, until recently, posed significant hurdles due to their inherent difficulty and cost implications. However, the technological landscape has witnessed remarkable advancements, sparking a burgeoning demand for mature 3D displays and diverse holographic visualization applications [1].

In contemporary contexts, 3D holographic technology has found its stride, extending its reach into communication, military training, entertainment, virtual augmented reality, and even medical training. While predominantly developed and utilized outside educational settings, holographic technology harbors immense untapped potential within the realm of education. Serving as more than a visual spectacle, holographic technology has the capacity to reshape educational dynamics, fostering a student-centered learning environment that propels learners into interactive spaces, facilitating knowledge construction through individualized experiences. The genesis of holographic technology dates back to 1947, with scientist Dennis Gabor's groundbreaking invention. Unlike traditional photographs, holograms capture the "phase" of light, imparting a distinct three-dimensional appearance. The term "hologram" itself reflects its essence—derived from the Greek terms "holos" for "whole view" and "gram" meaning "written". This technique involves scattering light from an object and presenting it in a three-dimensional form, observable either through 3D glasses or illuminated holographic prints [4]. While mature 3D displays hold transformative potential across various fields, including aerospace engineering, biomedical engineering, engineering design, art, advertising, and geological exploration, holographic technology has transcended its initial novelty. Today, holograms seamlessly integrate

into everyday life, adorning credit card chips, paper currencies, retail scanners, and even biomedical devices. What was once confined to static analog holograms in the 1980s and 1990s has evolved into a dynamic 3D holographic era, driven by sources such as geographical data, medical scanning, CAD design, simulations, low-cost depth scanners, cinema or TV, and 3D printing. As we stand on the precipice of this holographic renaissance, this research embarks on an exploration into the educational potential of 3D dynamic holographic technology. By unraveling its historical foundations, technical intricacies, and contemporary applications, we aim to shed light on a paradigm shift that promises to redefine the way we perceive, engage with, and learn from holographic content. In the realm of cutting-edge visual technologies, holography stands as a pinnacle of innovation, captivating our imagination with its ability to project three-dimensional, lifelike images into space [3,7]. The advent of Unreal Engine, a powerful and versatile game development platform, has opened up new possibilities for creating immersive holographic experiences. In the ever-evolving landscape of immersive technologies, holography has emerged as a transformative force, transcending traditional boundaries and opening up new dimensions of interactive experiences. In 2019, the third generation of holoprinter called CHIMERA<sup>1</sup> by Gentet et al is based on three low-power red, green, and blue continuous lasers combined with the silver-halide material ultimate U04<sup>2</sup>, and prints digital holograms with a 50 Hz speed, a 120° full-parallax and a hogel resolution of 250 μm. The recording of a CHIMERA requires the prior acquisition of a series of perspective images—points of view of the 3D scene. For a half-parallax hologram up to 768 horizontal images are recorded on a 120-degree arc of a circle and for a full-parallax, the procedure is repeated up to 192 different levels of elevation, creating a cylinder of points of view as shown in Fig. 1 for a total of 147456 images [2].



**Figure 1. CHIMERA recording procedure. (a) top (b) left**

In the ever-expanding realm of 3D computer graphics (CG) modeling, the creation of CHIMERA holograms has long been intertwined with the capabilities of prominent software tools like 3ds Max, Blender, and Maya. Yet, the journey from conceptualization to realization has not been without its challenges, notably the sluggish rendering times that have often hindered the seamless generation of CHIMERA holographic images. As we delve into the intricate world of holographic visualization, this research embarks on a quest to transcend the limitations of traditional CG modeling programs, steering the course toward efficiency and innovation through the dynamic capabilities of Unreal Engine. Working in real time, game engines offer a better solution. Unreal Engine<sup>4</sup> is the most famous and powerful game engine of the moment. It is free and freely available. This study shows how to use Unreal Engine to create perspective images and content for CHIMERA hologram with different ready-to-use OBJ file models. Table 1 serves as a

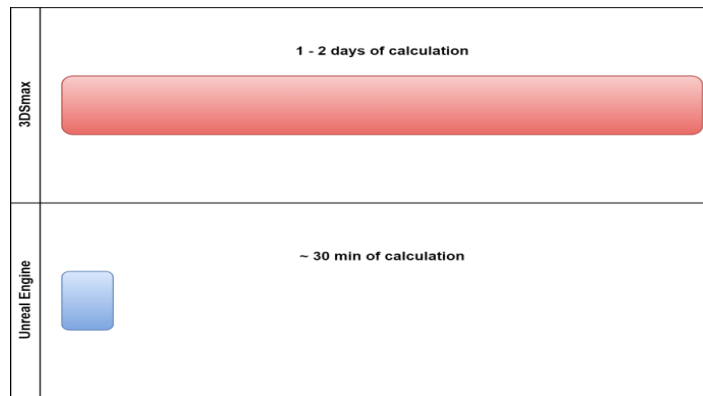
comprehensive guide, presenting a detailed comparison of features between Unreal Engine and 3ds Max. This comparative analysis seeks to unravel the strengths inherent in each platform, shedding light on why Unreal Engine emerges as the optimal choice for CHIMERA hologram creation. From rendering speeds to functionality, this table serves as a valuable resource for creators navigating the landscape of holographic content creation [5,6].

*Table 1. List of features (Unreal Engine vs 3DSmax).*

<b>Feature</b>	<b>3ds Max</b>	<b>Unreal Engine</b>
<b>Primary Purpose</b>	3D modeling, animation, and rendering software	Game development, real-time rendering
<b>Real-Time Capabilities</b>	Limited real-time capabilities	Powerful real-time rendering engine
<b>Rendering Engines</b>	V-Ray, Arnold, Mental Ray (discontinued)	Built-in rendering and support for third-party engines (e.g., Nvidia, UE Light)
<b>Supported File Formats</b>	fbx, max file	fbx, obj, gltf, glb, usdf files
<b>Marketplaces</b>	Autodesk App Store	Large free marketplace (e.g., Megascan, Quixel Bridge, Epic Marketplace)
<b>Software Nature</b>	Proprietary	Free and open-source
<b>Learning Resources</b>	Extensive documentation and online resources	Robust community support, extensive documentation
<b>Application Areas</b>	Film and TV production, architectural visualization	Video games, virtual reality, architectural visualization
<b>Cost</b>	Commercial software with various licensing options	Free to use for development; royalties for commercial products

This comparison provides an overview of the strengths and use cases of both 3ds Max and Unreal Engine. The choice between the two often depends on the specific needs of the project, such as whether real-time capabilities, game development, or film and TV production are the primary focus. Fig. 2 presents the 660×880 pixels Calculation speed of Unreal Engine & 3DSmax.

Figure 2 shows the speed difference between the calculation speed of Unreal Engine and 3DSmax of 660x880 pixels.



**Figure 2. 660×880 pixels Calculation speed (Unreal Engine vs 3DSmax)**

## **Materials and methods**

### **2.1 Computer configuration**

Unreal Engine's Material Editor stands out as a pivotal tool empowering developers to craft intricate and visually compelling materials that enhance the realism of holographic objects. This feature plays a crucial role in creating immersive holographic experiences, allowing developers to tailor materials to achieve specific visual effects. Notably, the Material Editor enables customization for transparency, refraction, and holographic glows, providing a rich set of tools to simulate diverse holographic surfaces and behaviors.

In the realm of holographic rendering within Unreal Engine, the importance of computer features cannot be overstated. The performance, capabilities, and overall quality of gaming or simulation experiences are intrinsically tied to the specifications of the underlying hardware. Unreal Engine's prowess in rendering holographic content is, to a significant extent, contingent upon the computational power and capabilities of the system it runs on. For aspiring developers seeking to harness the capabilities of Unreal Engine, the minimum system configuration is a critical consideration. The specified requirements for a Windows-based system include Windows 7 64-bit, a minimum of 64 GB RAM, a 256 GB SSD for the operating system, a 2 TB SSD drive, and an NVIDIA GeForce GTX 970 graphics card.

These specifications ensure that the hardware meets the demands of Unreal Engine, providing a solid foundation for seamless holographic rendering and a fluid user experience. It is imperative to acknowledge that the computational prowess of the system directly influences the speed and efficiency of holographic rendering within Unreal Engine.

The combination of a powerful GPU, ample RAM, and high-speed storage contributes to the optimization of holographic content, allowing developers to push the boundaries of visual fidelity and deliver captivating holographic experiences to end-users. In essence, the synergy between Unreal Engine's Material Editor and the underlying computer features establishes the groundwork for a successful exploration of accelerated CHIMERA hologram rendering.

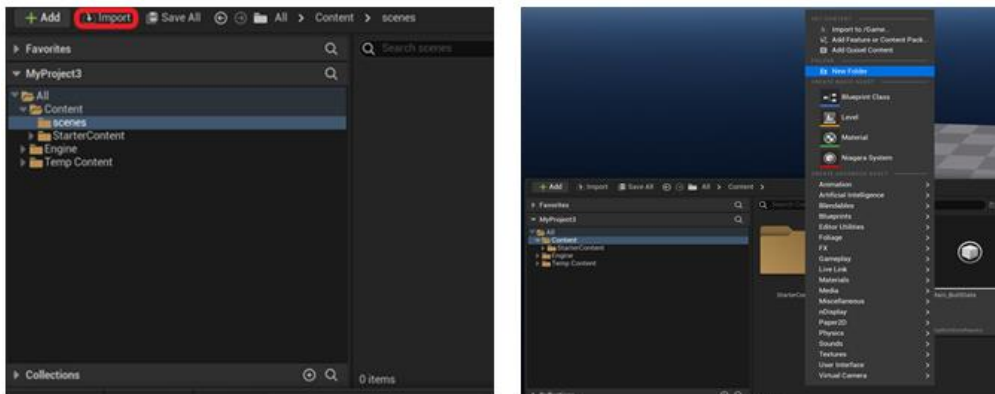
This intersection of powerful development tools and robust hardware configurations is pivotal in achieving the seamless integration of cutting-edge holographic technologies within the Unreal Engine environment.

### **2.2 Method to create content with Unreal Engine**

#### **2.2.1 Import 3D model**

Start by creating or obtaining your 3D models. This can be done using a variety of 3D modeling software tools such as 3ds Max, Maya, Blender, and more. Once your models are complete, you'll need to export them from your modeling software in a file format that is compatible with the Unreal Engine.

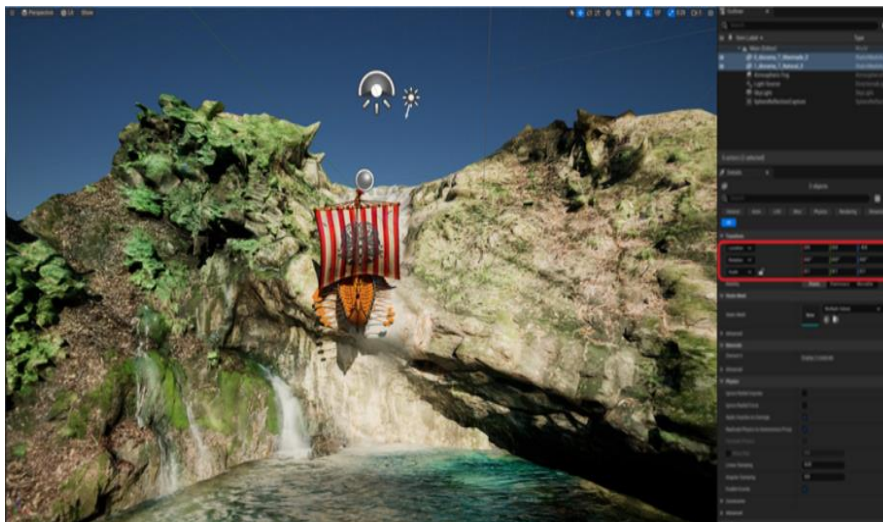
For import 3D formats that are best for importing into Unreal Engine. These formats are glTF, usdf, fbx, or glb. Figure 3 shows how to progress a 3D model file into Unreal Engine. Open the Unreal Engine and create a new project or open an existing project where you want to use your 3D models. You can also drag and drop the file into the content browser.



**Figure 3. How to Import 3D model(Unreal Engine)**

#### 2.2.2 Resize or modify your 3D model

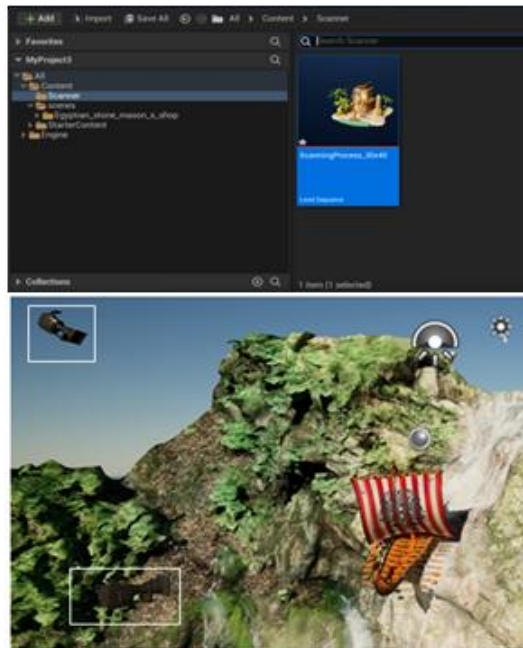
An import options panel will appear where you can select the settings required for your model. When you drag and drop your 3D model on the scene, your model appears larger; we need (sometimes) to reduce this size. To do this, select your 3D model in the Outliner (top right interface) and go to Transform and Scale. Change the scale value to something smaller (like 0,1) for all axes and set the location to zero like Figure 4.



**Figure 4. Resize or modify (Unreal Engine)**

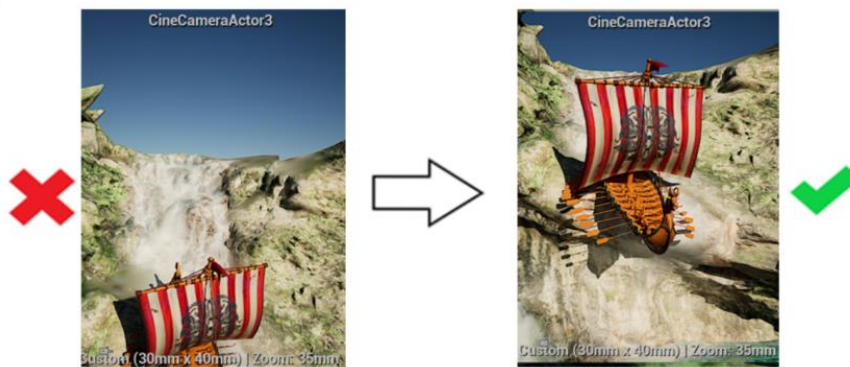
#### 2.2.3 Use the scanner script

To open the scanner script, go to the scanner folder in the content drawer and select “ScanningProcess\_30x40”. Normally two cameras appear “cineCameraActor” is the camera that will record the scene and “cineCameraActor3” is the camera that will help manage the scene. Check the position of the two cameras in Figure 5.



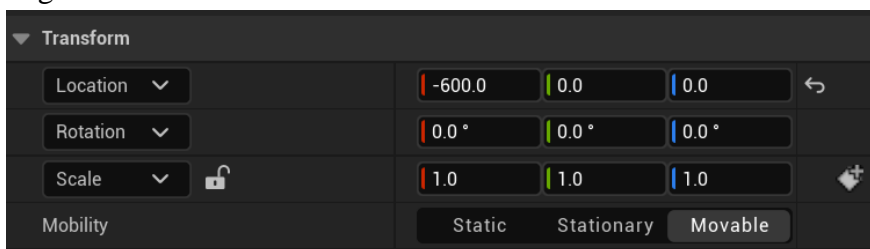
**Figure 5. Unreal Engine script cameras**

Now let's readjust the 3D model (resize, move, rotate), this view represents the front (zero position) of the final hologram. Fig 6. shows the incorrect and correct positions of the 3d model.



**Figure 6. Correct positioning (Unreal Engine)**

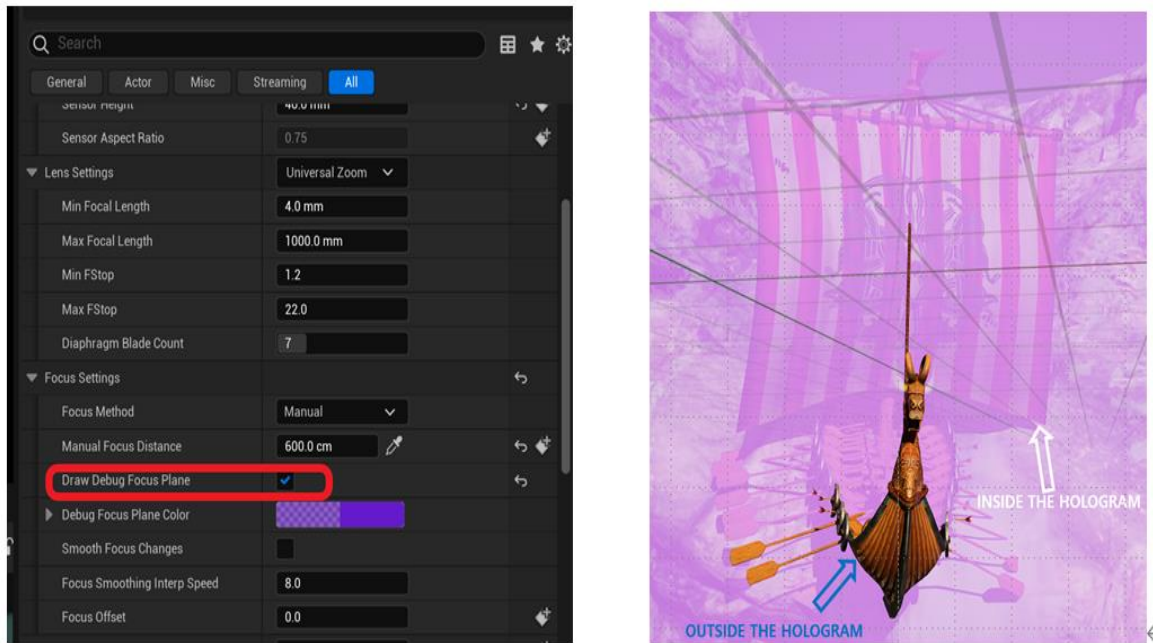
Procedure, the camera may move by mistake, be sure to always adjust the settings as in the images below. fig 7. It is possible to change things such as the size, angle, and position of the 3d model by entering numbers.



**Figure 7. Location, rotation, scale screen (Unreal Engine)**

When you are satisfied with your front view, you need to adjust the depth of your hologram. To do this, select in the **Outliner** "CineCameraActor3" go to "Focus Settings" and select "Draw Debug Focus Plane".

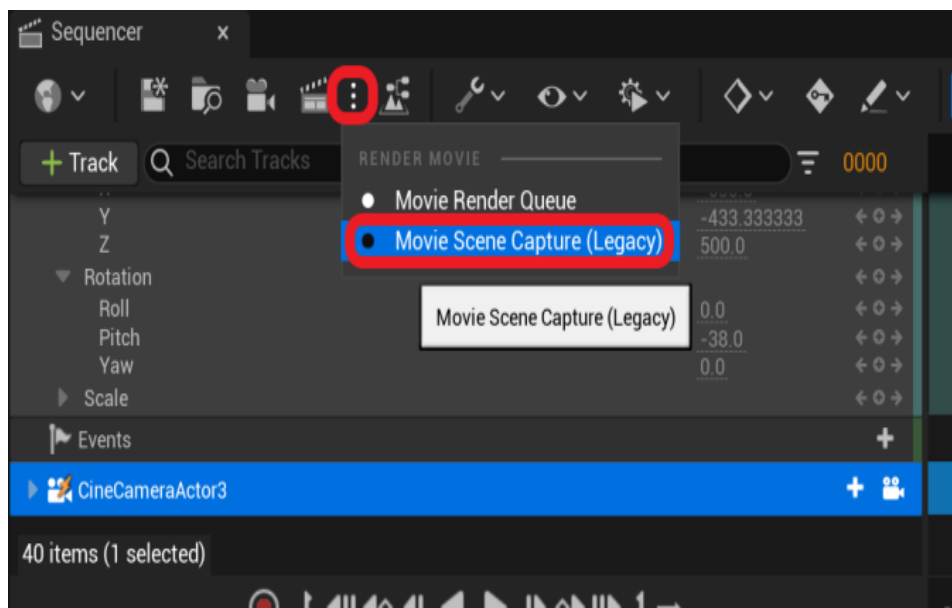
This plane represents the plane of the final hologram, everything behind this plane will be inside the hologram and everything above this plane will float outside the hologram. Which is shown in Fig. 8.



**Figure 8. The inside and outside positions (Unreal Engine)**

#### 2.2.4 Launch the scanner script

Go to the sequencer panel to launch the script. Go to the “Render Movie” option and select “Movie Scene”



**Figure 9. Capture (Legacy)**

After doing this, go to Render Movie Settings and modify, like Fig 9, the information of the Image Output Format, Resolution, and Output directory.

And start “Capture movie”. Then, as shown in Fig.10, multi-view images are created in the folder where you set up the save. Once we have our 3D model, that need to convert it into holographic data.

This involves obtaining multiple perspective views of the 3D model, similar to the process described earlier.

Each perspective view is then used to generate holographic information for the corresponding hogels in the hologram



*Figure 10. Multi-view images*

### Results

Printing a hologram is similar but much more complex, recording individual “hogels” (“hologram elements”) with laser light, and a complete 3D hologram image can be seen on the film when viewed together. The 3D Hologram Printer takes multiple perspective images, captured from a camera, video footage, or rendered from a typical 3D graphics design. The images are sliced into unique recordings for each individual hogel on the hologram. The printer then optically encodes that hogel information with laser light onto the special hologram film. The Unreal Engine creates colorful modeling in a shorter time than any other modeling program, and the rendering speed is also very fast, so it works best with digital holograms. Fig. 11. shows a digital hologram made with Unreal Engine. When complete, the hologram recreates the many different perspectives as if the 3D image is truly there, giving you the ability to look around the image to see different angles.



*Figure 11. Result of hologram (Unreal Engine)*

### Conclusion

3D software is an integral part of the digital holography workflow, enabling the reconstruction, manipulation, and analysis of holographic data for various applications in fields like microscopy, metrology, and holographic displays. In this paper, Comparing 3dsmax with Unreal Engine, Everything is better than 3dsmax, whether it is color or graphic, and Unreal Engine only takes about an hour to produce multi-view images, while 3dsmax takes more than a day to produce multi-view images. Unreal Engine proposes a new, simpler, and faster way to create more realistic and complex content for chimeric digital holograms. The method aims for the widespread dissemination of display holography. The final result of hologram can be viewed by illuminating



it with coherent light, such as laser light. This light interacts with the printed interference patterns, reconstructing the three-dimensional image and making it visible to an observer.

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