Thesis

University of the Arts London

MA Visual Effects

“How Do Visual Effects with Photorealism and Anamorphosis Enhance Immersive Experiences?”

Moonju Youn

Abstract

This study explores how photorealism and anamorphosis applied to visual effects (VFX) enhance immersive experiences. The capability of photorealists to reproduce the real-world visual through various techniques has become essential. Anamorphosis has historical roots in the arts and functions with viewers due to intentional distortion based on the viewpoint about perspective. There have been independent explorations of these techniques in fields such as advertising and filmmaking, but their integration within VFX remains unexplored.

I discussed the research into the technical and creative phases that contribute to the creation of immersive and photorealistic optical illusions. Adopting the practice-based methodology, the study investigates existent anamorphic screen art and experiments with VFX software in order to make believable anamorphic illusions. The findings highlight the importance of precise perspective alignment, advanced lighting, and material configurations to achieve convincing VFX.

Throughout the thesis, both theoretical and practical understanding of VFX provide how they can create engaging and believable visual narratives, revealing its potential to redefine immersive storytelling across fields such as filmmaking, advertising, and interactive media.

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Introduction

In the modern filmmaking industry, visual effects (VFX) have become an essential part of creating believable and engaging visual experiences. A VFX supervisor, Dinur (2021, p.9), has mentioned the term “photoreal” as visuals that closely resemble photographs. This is a straightforward definition that encapsulates the fundamental goal of VFX. Since human vision has not yet been recorded or shared with others using contemporary technology, all visuals must be captured through a camera. This has led filmmakers to pursue realistic and engaging visuals the most in a film as a part of the visual narrative. In VFX production, advanced techniques for creating computer-generated imagery (CGI), such as lighting, rendering, texturing, and modeling, have played a fundamental role that contributes to realistic and convincing visuals for the viewer, enabling them to feel those are a natural part of the video. Thus, photorealism has remained one central concept in VFX that aims to replicate real-world visuals as similarly as possible. Techniques have been constantly evolving to achieve more precise and realistic results, ultimately making it look as if captured through an actual camera. Achieving photorealistic VFX has required continually advancing methods, which this study will explore in depth.

These developments have brought new forms of immersive experiences, including stereoscopic three-dimensional (3D) films, which engage audiences more effectively but still require specific viewing tools. Curved screens and anamorphic screen art have recently revealed possibilities for overcoming these limitations using optical illusions created by anamorphosis. Combined with anamorphic screen art — which utilizes optical illusions and perspective techniques to manipulate images based on the viewer's position— the outcome turns into a deeply immersive experience. This integration has expanded the possibilities for visual effects (VFX) applications, not only in films but also in fields like advertising. This study

investigates the potential of combining anamorphosis with photorealism in VFX to achieve a heightened immersive experience.

Despite anamorphosis' artistic history, its technical adaption to digital content is a comparatively new skill. Research related to the adaptation of anamorphosis techniques to VFX remains limited. Yassin (2023) provided the fundamentals of the anamorphosis technique and analyzed various anamorphic screen arts, focusing primarily on the aspect of advertising. Ayada and Abdullah (2024) further explored the effectiveness of anamorphic illusion technology in enhancing brand loyalty and consumer engagement, emphasizing how anamorphic projection can captivate audiences unexpectedly, thus deepening the emotional connection with brands. Additionally, Linwei et al. (2023) offered a detailed workflow to create 3D screen art from a technical aspect, while Linwei and Yun (2024) described an advanced approach to reduce distortion in the rendering process. However, existing studies are still to be more since they did not address methods in the aspect of VFX.

Accordingly, in this study, I aim to produce a VFX-based video that achieves photorealistic visuals in a practical environment, exploring technical aspects in depth and referring to the technical guidelines provided by Linwei et al. (2023). This study offers both academic and practical significance by analyzing existing anamorphic screen art and applying its fundamental elements to create an engaging and immersive VFX video. By experimenting with VFX software like Cinema 4D (Maxon, 2024), this research identifies an answer to the research question: How do visual effects with photorealism and anamorphosis enhance immersive experiences?

Literature Review

As VFX became essential to the modern filmmaking industry, they enabled directors to create fantastical worlds and recreate real-world scenes by bridging the gap between imagination and what the camera captures. This development widened the possibilities of storytelling, evolving from practical effects to contemporary cutting-edge technologies. These effects not only conveyed spectacular visuals but also provided emotional impact by supporting storytelling (Mandapuram, 2022).

According to Joon's review (2010), photorealism was defined as the idea of reproducing a scene as realistically as possible in CGI. He emphasized that this contributes to enhancing storytelling and the relationship built within the scene. Principles of photorealism, such as specular, scratches, and material depth, which help VFX artists achieve photorealistic rendering, were also provided in the study. One of the factors mentioned in the study was depth of field (DOF), which was defined as the distance between the object and the camera affecting focus. This was noted as a crucial part of the camera technique as this helps visualize objects and surroundings.

Supporting his idea, Dinur (2023) considered photorealism as a vital part of VFX because they were continuously judged on how realistic they looked as a part of the film. All images captured by a camera are photorealistic by themselves; however, VFX must match them to be realistic. He also emphasized the application of a judicious approach with respect to physics and optics from the real-world.

To achieve an immersive experience, several factors should be considered. Jones (2023) discussed how digital effects can enhance realism and create fantastical views with the varied use of VFX in films and TV shows. He stated that however convincing the VFX looks, visuals from non-physical realms like dinosaurs might reduce their realism.

On the contrary to this, Budianto et al. (2022) contended that even if they do not exist in the real-world, hyperrealistic effects enable audiences to consider they are real by presenting unrealistic elements naturally in the film. They also emphasized hyperrealistic elements as tools for supporting audiences' immersion in the film.

According to Bennett and Murphy (2020), drawing audiences' attention through camera angles and post-production edits was not effective when viewers were not forced into a single point. They highlighted the challenge of enhancing the immersive experience, particularly in flat media like film and TV.

Using anamorphosis, shapes are represented on surfaces by a projected image that is recognizable only from a predetermined point; when seen from other perspectives, it appears deformed. This optical perspective can be applied to various methods such as advertising, industrial design, and urban planning (Paola et al., 2015). Moreover, they mentioned the application of this optical technique to digital representation as a tool to enhance storytelling and audience experience.

This technique has evolved from a traditional linear perspective. What differentiated the anamorphosis technique from other camera techniques is that artists could force the viewer's perspective (Joseph, 2021). This offered a way to enhance the immersive experience for audiences by creating more dynamic and engaging visual narratives.

As an approach to film, the format's frames played a pivotal role in determining anamorphic composition (Deutelbaum,2003). As elements in the screen constantly changed, dividing the frame into quarters created a grid that provided uniformity to each shot. Yassin (2023) stated that adapting to a 3D digital billboard gives audiences a vivid feeling and realistic visual experience. Principles for building up anamorphic screen art were also discussed, and various examples were analyzed. She said this approach provides immersive visuals drawing more attention and higher engagement.

In addition to her view, Ayada and Abdullah (2024) mentioned that anamorphic screen ads deliver a "wow" factor that captivates and holds the audience's attention. Moreover, these illusions encourage consumer interaction by sparking curiosity and promoting word-of-mouth sharing. As a result, they attracted attention and fostered meaningful brand-consumer relationships, ultimately enhancing loyalty and market differentiation.

Methodology

This research adopted a practice-based methodology to establish principles for creating practical anamorphic screen art. To determine positive or negative factors that influence the effectiveness of anamorphosis, various videos filmed from diverse perspectives on YouTube were analyzed as a case study. Still images of each video were attached to illustrate how the factors appear directly on the screen.

To explore how optical illusions can be further refined to enhance viewer immersion, an anamorphic VFX sequence using photorealistic techniques was created as a part of the case study. This process involves documenting and iteratively refining methods for lighting, texturing, and perspective mapping to achieve realistic and immersive effects. The object Humpback Whale by GoldenZtuff (2022), including animation and texture, was sourced from Sketchfab to optimize time and focus on camera and rendering techniques. In Cinema 4D, this model was arranged and composed spatially, with the camera positioned based on the measurement of the real-world environment. Lighting and camera settings were meticulously adjusted, after which the final scene was rendered offline with Redshift renderer (Maxon, 2024). The renderer was chosen due to optimization of the real-world simulation conditions. The whole creation process was recorded for later analysis.

This methodology has limitations in that it relies solely on self-assessment as it does not incorporate feedback from any viewers. In addition, due to the difficulty of approaching practical billboards, the case study was conducted in the virtual realm, not in the real world.

Chapter 1. How Can Photorealism Be Achieved in Anamorphic Screen Art Using Current VFX Technologies?

1.1. Photorealism

As an artistic and technical discipline, photorealism has significantly affected paintings, VFX and various creative mediums. During the late 1960s, photorealism originated in the United States, particularly in California and New York. Photorealists reintroduced realism as a counter response to the abstractionism of modern art movements such as Pop art and Minimalism, utilizing photography as a reference and a foundational means in their creative processes (Sultan, 2017). A gallery owner, Louis Meisel, coined the term “photorealism” in 1969 by recognizing the artists who referred to the intricate details of their works through cameras and photographs. They used photographs not just as a tool but as the subject of their creations. By reconstructing photographic visuals, photorealists managed to capture reality from different perspectives. Photographs reproduced in paint emphasized the reproduction qualities of the photographs themselves, accentuated the differences between human and photographic visions, and highlighted the technical nuances of translating a photo into another medium (Lash, Lord & Meisel, 2014).

The principles of photorealism extend into VFX, where creating digital imagery that replicates real-world environments is predominant. Achieving photorealism in VFX requires a sophisticated insight of how light, material, and shadow interact in environments while blending digital elements seamlessly with advanced techniques such as physically based rendering (PBR) and global illumination (GI). In this context, photorealism is more about integrating digital elements seamlessly into live-action footage, thereby creating a unified and convincing visual narrative. Key concepts to achieve photorealistic VFX are distributed across general production stages: modeling, texturing, lighting, rendering, and compositing.

Modeling and texturing establish the foundation for photorealistic imagery. While meticulously designed creatures and surroundings leave a strong impression, applying subtle elements can significantly enhance realism. In real-world environments, objects rarely feature perfectly sharp corners or uniform surfaces; instead, slight imperfections such as beveled edges, dirt and scratches on surfaces are essential to simulate how light naturally interacts with realistic surfaces. Once shapes are established, textures define the characteristics of each material, which provides the visual cues necessary to distinguish surfaces. Advanced texturing can enhance low-resolution modeling quality while undermining perfectly modeled objects with poor-quality textures. Thus, VFX artists must ensure that texture maps align with their models with believable details. It is imperative to maintain consistency with the physical properties of the real-world to enhance the overall visual authenticity.

Lighting and rendering play a pivotal role in creating photorealistic visuals. Techniques such as PBR and image-based lighting (IBL) mathematically calculate how light interacts with real-world environments. The seamless integration of digital elements and live-action footage is achieved using real-world light samples and environmental reflections. GI ensures an accurate representation of indirect lighting and dimensionality of the scene by calculating the bouncing of light between surfaces. To create a sense of realism, precise control of shadows, reflection, and refractions is crucial. In particular, shadows must align with the scale and placement of objects, while reflections on glossy or metallic surfaces must react dynamically to their environments.

Finally, compositing enhances rendering results by adding details such as depth-of-field effects, atmospheric depth, and chromatic aberrations. Those elements are sometimes considered too subtle; however, audiences can notice them with subtle, strange impressions, which eventually can disrupt the immersive experience of films (Dinur, 2021).

1.2. Anamorphosis

The term anamorphosis originated from the Greek words ana (again) and morphe (shape). It refers to the intentional distortion of an image that can be recognizable only when viewed from a specific viewpoint or through a particular apparatus. Anamorphosis has been studied based on the exploration of perspective and has been influenced by advancements in geometry, optics, and artistic innovation (Leeman, 1977).

Early explorations of anamorphic illusions can be traced back to the Renaissance, where artists like Leonardo da Vinci introduced sketches of a child's head and an eye which regain their original proportions when viewed from a specific angle. Its principles were explored by various artists and theorists during the 16th century. For example, perspective grids to create distortions enabling precise geometrical guidelines explored by Albrecht Dürer. As artists and scientists converged to study perception, the participatory aspect resonated with the Renaissance's broader intellectual pursuits (Baltrusaitis, 1977).

Over time, the principles of anamorphosis have evolved and found their application to diverse fields of human life such as advertising, filmmaking and urban planning. Application to anamorphic lenses has created impressive results for storytelling in contemporary filmmaking. With these lenses, images were captured in distorted perspective, which creates cinematic widescreen, contributing to a more immersive experience. In addition, the evolution of CGI techniques has allowed the principles of anamorphosis to be achieved in the digital realm. With the combination of photorealism and anamorphic techniques, this approach has proved particularly transformative in the advertising field. Consequently, VFX artists have been able to create experiences that are both realistic and interactive, giving viewers a new perspective on visual perception and artistic innovation.

1.3. How Do These Techniques Enhance the Immersive Experience?

Immersive experiences rely on the believable reconstruction of reality, building a sensory and emotional connection between audiences and the visual narrative. The combination of

photorealism and anamorphosis provides a unique opportunity to enhance this immersion by blending realistic visuals with perceptual distortions. These techniques, individually and collectively, transform visual storytelling into a more engaging, interactive, and believable experience. As Ayada and Abdullah (2024) indicated, anamorphic advertising methods increase engagement by using manipulated perspectives in order to captivate viewers into the narrative. These techniques extended into digital domains where CGI-driven anamorphic illusions adapt dynamically to the viewer's position, turning static visuals into interactive spatially responsive environments. This dynamic interaction heightens the sense of presence and provides a compelling visual experience.

The combination of photorealism and anamorphosis enabled visually authentic and engaging environments to be constructed. While photorealism anchors the viewer in a realistic representation of reality, anamorphosis adds an element of perceptual interactivity and surprise. This becomes particularly transformative in virtual reality applications where the environment would adjust to the user's perspective, enhancing this overall sense of immersion. This integration lets VFX artists and filmmakers create narratives that engage many sensory modalities. Whether film, advertisement, or interactive media, this approach bridges the gap from static visual fidelity to dynamic perception, hence creating an enchanting visual experience with new possibilities in visual storytelling.

Chapter 2. Case study – Analysis of Anamorphic Screen Art

Anamorphic screen art, also known as Naked eye 3D effect or 3D billboard, represents a highly innovative medium that bridges the gap between art and technology. First introduced in 2019 in Seoul, South Korea, it has since drawn worldwide attention with its capacity to captivate audiences with striking and immersive optical illusions. As Ayada and Abdullah (2024) noted, this medium presents huge potential for the enhancement of brand memory and building emotional connections with the audience.

This chapter analyzes in detail the principles and methods behind successful anamorphic screen art. By analyzing exemplary works, this discussion will establish which elements recur in order to contribute to the effectiveness of the anamorphic illusion. Additionally, the challenges and improvements that some examples encountered will be analyzed, considering how to overcome them to realize better implementations in the future.

2.1. Key Elements in Successful Anamorphic Screen Art

Anamorphic screen art relies on the delicate interplay of perspective, rendering, and spatial design to create its characteristic visual impact. The following examples illustrate how these principles are utilized to engage and captivate viewers.

2.1.1. KIA Brand Renewal Immersive DOOH Commercials (d'strict, 2021)

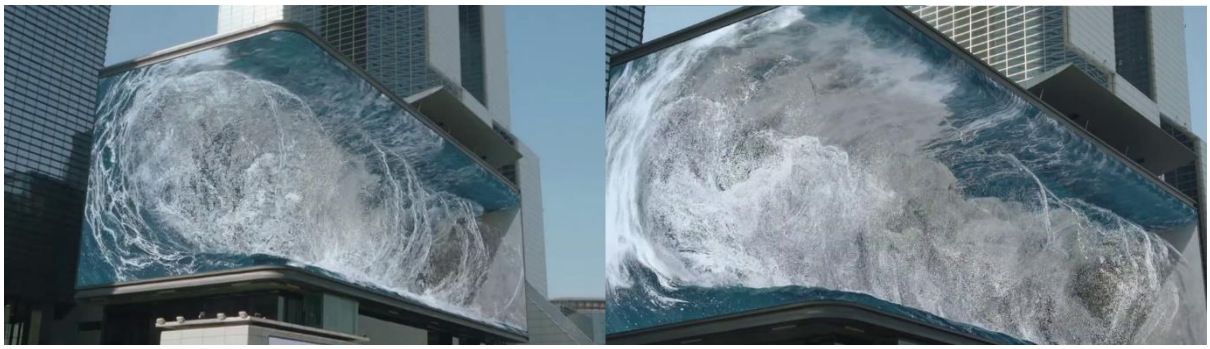


Figure 1. Stills from ‘KIA Brand Renewal Immersive Commercials’ (2021)

This advertisement depicts a massive wave that appears to crash overhead, generating an intense visual illusion. The technique utilized in this video relies on minimizing the screen’s

visible edges, which allows the display to seamlessly resemble a large water tank. The clear separation between the background wall and other visual elements enhances the depth illusion, while the realistic rendering of the wave and strategic use of shadow contribute to the screen's convincing portrayal of a tangible space.

2.1.2. Naked Eye 3D LED Display Vivo X80. DOOH advertising billboard (Bonum Abstraction., 2022)

Figure 2. Stills from Naked eye three-dimensional (3D) display advertising video (2022)

In this instance, a floating phone moves through a screen accompanied by a cascading waterfall. The illusion's effectiveness is achieved by using simple yet precise movements of the phone. White edges frame the screen's boundaries, while darker margins create the impression of depth beyond the visible frame. By employing exaggerated perspectives in the phone's motion, the advertisement effectively enhances the anamorphic illusion, making the phone seem as though it is emerging into real-world space.

2.1.3. Hong Kong Disneyland Momentous (AIR Concepts, 2022)

Figure 3. Stills from 'Hongkong Disneyland Momentous' (2022)

A display from Hong Kong Disneyland (Fig. 3.) presents the illusion of a building facade dissolving under mysterious lighting to reveal a wizard character. A unique feature of this example is its integration with the surrounding architecture. The screen mimics the exact appearance of the building exterior, seamlessly blending with its environment. Instead of outlining the screen with a black frame, natural elements such as trees and pillars are used to obscure its edges. Dynamic changes in the character's size heighten the perception of depth, creating a compelling and immersive experience.

2.1.4. Public Media Art "ART PERFORMANCE" (d'strict, 2021)

Figure 4. Stills from 'Art performance' (2021)

This installation showcases the silhouette of a person moving behind opaque glass suggests a space extending beyond the screen. The depiction of a three-dimensional hand emerging from this "glass" amplifies the tactile realism. Unlike conventional methods that emphasize screen boundaries, this approach utilizes the entire screen area to craft a more nuanced and sophisticated visual effect.

Key Findings

The analysis of these examples reveals several important elements for enhancing the immersive quality of anamorphic screen art:

1. Clearly defining the spatial boundaries of the screen;
2. Using boundary-breaking effects to blur the distinction between screen and reality;
3. Employing dynamic movements such as scaling, particularly along the curving edges

of the screen; and

4. Ensuring a high degree of realism in rendering, though this is not always necessary for creating an impactful illusion.

2.2. Challenges and Areas for Improvement

While many examples demonstrate the strengths of anamorphic screen art, others highlight potential issues and limitations. Three cases were analyzed to identify areas where considerations and improvements can be made.

2.2.1. The talk of the town! Samseong-dong New Year's celebration ‘The Tiger is Coming’ [장안의 화제! 삼성동 새해맞이 ‘범 내려온다’] (Sangwha, 2022)

Figure 5. Stills from ‘The Tiger is Coming’ (2022)

In this video, a white cow and a black tiger are depicted with detailed, realistic fur simulation. However, the intended illusion is less effective due to filming from a perspective that does not align with the producer’s vision. The closer and lower filming angle diminishes the sense of depth, making the objects appear less three-dimensional. Additionally, the tiger’s scale was insufficiently exaggerated compared to the cow, reducing the overall impact of the illusion.

2.2.2. 3D Billboard in Beijing featuring a whale, a kangaroo and a dinosaur (Lantern Languages, 2024)

Figure 6. Stills from 3D billboard in Beijing (2024)

Another example of 3D billboard features animals and a dinosaur breaking through an icy wall. Despite incorporating key elements such as boundary-breaking movements, exaggerated scaling, and realistic rendering, the illusion is compromised by an incorrect alignment of the viewer's perspective with the intended standpoint. Furthermore, attempts to enhance depth perception through screen brightness variations inadvertently highlight the screen's physical edges and diminish its immersive illusion.

2.2.3. 3D Illusions | IKEA (Plan B Media, 2023)

Figure 7. Stills from IKEA advertising video (2023)

A case from IKEA's advertising includes animations of objects against a spatially intricate background. Distortion arises near the edges of the screen due to inconsistencies in perspective alignment. Unlike box-shaped perspectives, this display features bent edges, causing a disjointed appearance likely stemming from inaccuracies in 3D modeling or video format conversions.

Considerations

These cases emphasize the following points for consideration:

1. Aligning the filming angle with the intended viewpoint to maintain the integrity of the illusion;
2. Precisely calculating the dimensions of the screen and its environment during the production process; and
3. Ensuring that the elements identified in Chapter 2.1. are implemented with accuracy to maximize the immersive experience.

Chapter 3. Case study – Practical Experimentation with Anamorphic Screen Art in Cinema 4D

This chapter focuses on practical exploration of the principles of anamorphic screen art outlined in Chapter 2. Through experiments conducted in Cinema 4D, this study will investigate how camera positioning, material settings, lighting setups, and object composition contribute to the realism and effectiveness of the anamorphic illusion. These experiments aim to identify solutions to common challenges while enhancing the immersive experience of viewers. By examining perspective alignment, materials and lighting, the research will highlight how these elements influence perceived depth and realism, as well as best practices for designing immersive anamorphic displays.

3.1. Experiment Setup

The virtual environment was designed to mimic real-world billboard setups. Two screen configurations were used in the study: a large rectangular screen (20 meters wide, 8 meters tall, and 12 meters deep) and a smaller version measuring 10x4x6 meters. Both flat and curved screen variations were included to evaluate how screen shapes affect the effectiveness of anamorphic illusions. This variety allowed for a comparative analysis of different setups to understand their impact on viewer perception.

3.2. Camera Replacement

Accurate perspective alignment was identified as a crucial factor in achieving a convincing anamorphic illusion. To study this, a virtual camera was positioned at an average viewer's eye level (1.6 meters above ground) and placed 25 meters from the screen (Figure 8). This distance data was set based on Piccadilly Light, a giant billboard in Piccadilly Circus; the approximate distance was measured via Google Maps (Google, 2024). Observations showed that larger screens provided a wider optimal viewing zone on the same viewpoint, while smaller screens required more precise alignment due to narrower viewing angles (Table 1). In

the case of different types of screens, the right-angle screen performed a better immersive look than the curved screen; however, it had more severe distortion than the curved one when the viewpoint shifted. The following screenshots illustrate how screen shape and camera positioning influence the illusion (Table 2). Given observation, a large and curved screen could be a better choice to ensure less distortion with a more profound immersive experience.

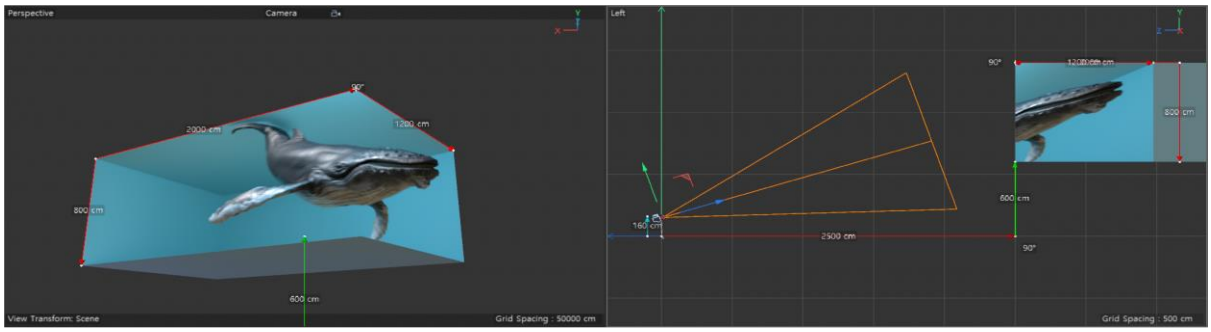


Figure 8. Screenshot of the screen and camera setup in Cinema 4D (2024)

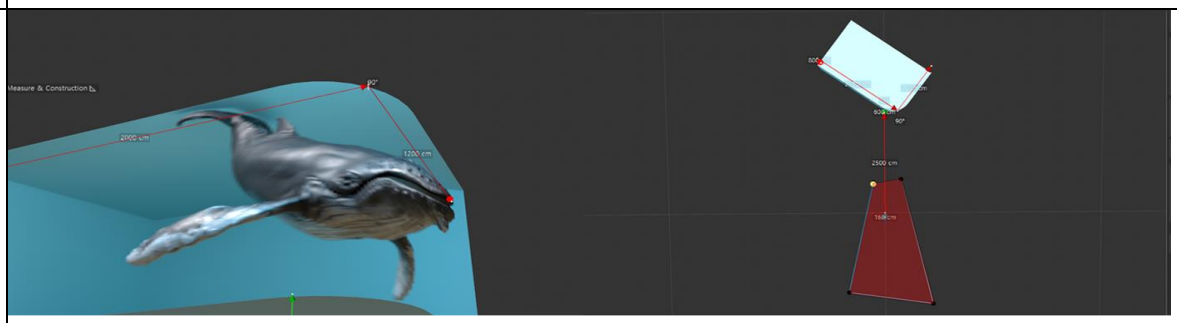
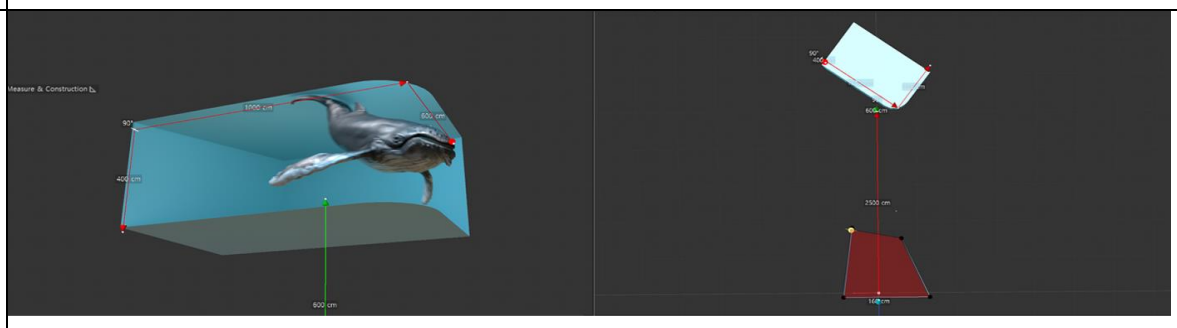
	Viewing area
Large screen	
Small screen	

Table 1. Comparison of viewing areas for large- and small-scale screens (Source: Youn, 2024)

	Correct viewpoint	Further viewpoint	Diagonally shifted viewpoint

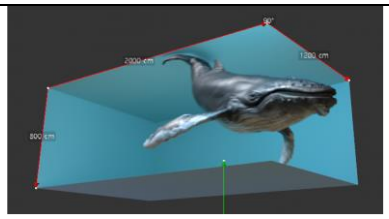
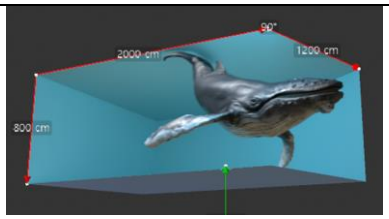
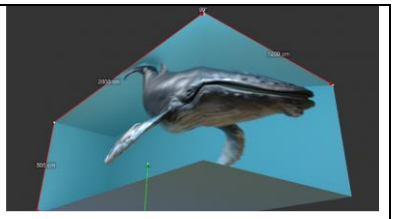
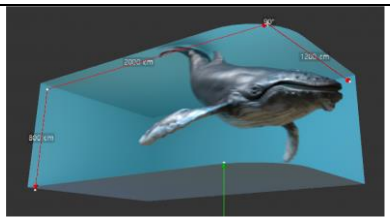
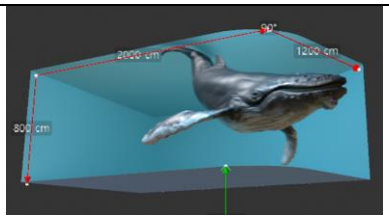
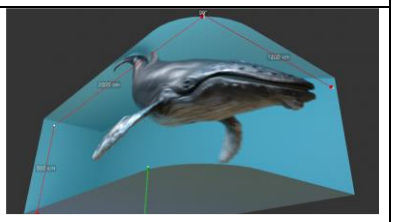
Right angle screen			
Curved screen			

Table 2. Distortion on the different viewpoints and screen types (Source: Youn, 2024)

3.3. Texture Baking

Anamorphic textures were created by baking them using the camera's perspective. A focal length of 0.035 meters was selected for the camera setup to replicate human vision closely. Textures were first rendered from the camera's viewpoint and applied onto flat or curved surfaces using camera-based wrapping techniques. After this applied material with camera view renders, bake its material based on the UVs, which refers to the coordinate system used for texturing mapping in 3D software, where the horizontal axis is 'U' and the vertical axis is 'V', of the model. Finally, the baked texture is applied with new material, replicating real-world billboard imagery (Table 3). This technique highlighted the importance of accurate texture mapping for preserving the illusion's integrity, ensuring a seamless transition from virtual to real-world applications. Additionally, this approach provided less distortion on the baked texture.

Right angle texture	Curved screen texture

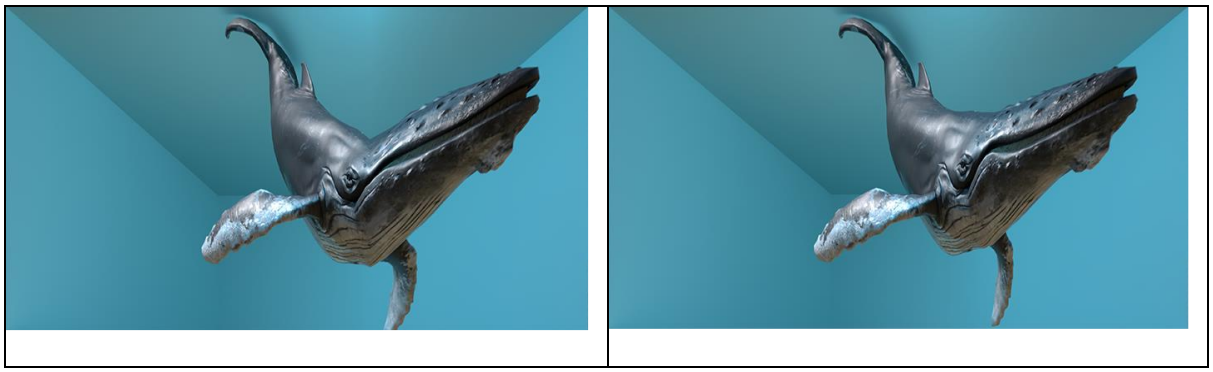


Table 3. Baked textures using material bake (Source: Youn, 2024)

3.4. Lighting and Material Comparisons

One of the most important factors that contribute to photorealistic VFX can be lighting and materials. The same model was rendered with different materials and lighting based on the same scene setup to compare how they affect reality.

The impact of materials on the illusion was examined by testing three different materials: a texture-less plain material, a material with reflections and textures, and a high-resolution texture with detailed normal maps and reflections created by the same shader of Redshift renderer (Table 4). The advanced materials provided significantly more realistic results. The plain surface, by contrast, reflected the surroundings well on the surface, though it reduced the visual depth, making the illusion appear dull and unconvincing.

Plain surface	Basic material	Advanced material
		

Table 4. Difference between three different materials (Source: Youn, 2024)

The lighting experiments compared two different light setups: default Cinema 4D lighting with basic configurations and high dynamic range imaging (HDRI) based Redshift lighting with area lights and detailed shadows. The model rendered with default point light showed

completely black, sharp borders on the shadow. Since completely black color cannot exist in the real-world environment, this can degrade the convincing look of the scene. On the contrary, HDRI environments enhanced depth perception and improved realism. As analyzed in Chapter 2, shadows played a vital role in defining the spatial relationship between objects and the screen, particularly when soft shadows were cast inward. Comparisons of these lighting setups (Table 5) demonstrate the significant impact of advanced lighting on the overall quality of the illusion.

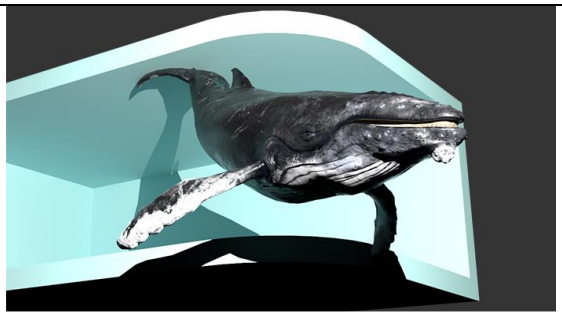
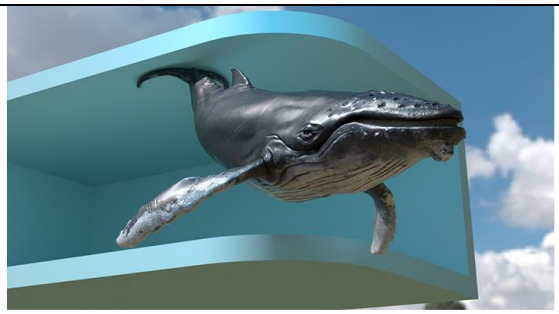
Default lighting	HDRI based lighting
	

Table 5. Comparison of two different lighting setups (Source: Youn, 2024)

3.5. Composition Setup

Object placement within the scene was analyzed to assess its impact on the viewer's perception of depth. The central placement of objects yielded the strongest illusions since it was observed in the camera replacement stage that the least amount of distortion happened on the curving edge when the viewpoint shifted. Compared with this, objects positioned near screen edges required exaggerated scaling and perspective adjustments to maintain realistic visuals. When the boundaries were added on edge with the adjustment of the object to cross the borders, even on a similar composition, it showed deeper spatial looks with the enhancement of immersive visuals (Table 6).

	Center position	Near the edges

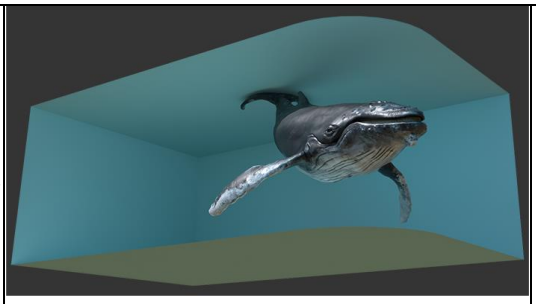
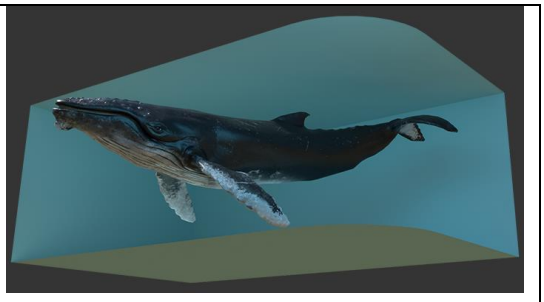
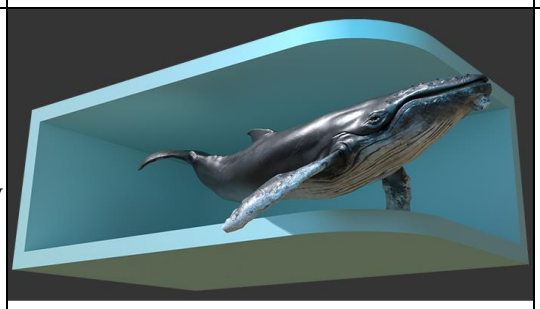
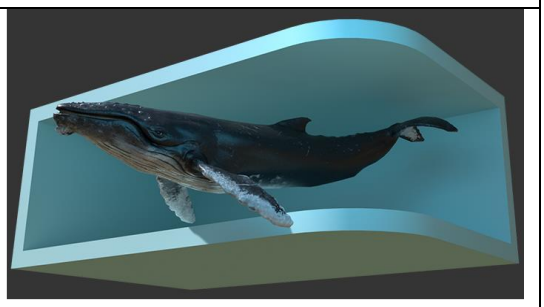
Without boundary		
With boundary		

Table 6. Comparison between each composition (Source: Youn, 2024)

Discussion

This thesis set out to explore the core principles underlying anamorphic screen art and test their practical application. The concept of photorealism forms the basis of VFX, which aims to recreate real-world visuals as closely as possible to create believable and engaging visual experiences. As filmmaking technology has progressed, digital techniques to achieve photorealistic visuals have continually evolved. Alongside this, anamorphosis, an optical illusion that is viewed from a specific predetermined standpoint, has been introduced, offering unique and captivating experiences. While existing studies have addressed anamorphosis in various fields, such as advertising and digital screen art, their focus has been limited to specific applications. For instance, Yassin (2023) and Ayada and Abdullah (2024) highlighted the role of anamorphosis in advertising to attract audiences, while Linwei et al. (2023) and Linwei and Yun (2024) examined the technical workflow and distortion reduction for a 3D billboard. However, these studies rarely demonstrated the combination of photorealism and anamorphosis from a VFX perspective. This study bridges that gap by analyzing both principles and creating a practical video with established factors, addressing how these combined techniques enhance audience engagement.

Chapter 1 reviewed the origins and evolution of anamorphosis and photorealism and established contemporary usages related to their combination in VFX. Expanding from the basic concepts established, Chapter 2 examined contributory elements leading to the success of anamorphic illusions using various existing examples. These include the deliberate creation and intersection of spatial boundaries, dynamic motion, and realistic rendering to ensure convincing imagery. Chapter 3 extended this exploration by recreating these principles in Cinema 4D through controlled experiments. In the practical experiment, perspective alignment, material, and advanced lighting configurations were found to be essential for successful anamorphic screen art with compelling VFX. Additionally, the experiments highlighted the

significance of technical precision in preserving illusions across different screen types and viewing angles.

Linwei et al. (2023) utilized Maya as a methodology to create and render the scene, which is different from this study, which utilized Cinema 4D. Since their approach did not involve the concept of camera-based mapping, there was the limitation that they needed additional adjustment to deal with the distortion on the edge in external software like After Effects. A subsequent study by Linwei and Yun (2024) experimented with a better approach to reducing distortion using a real-time renderer. While camera-based mapping in Cinema 4D minimizes the need for post-rendering corrections, the software's extended rendering times present a limitation. The real-time renderer approach can be a time-efficient alternative, maintaining a deeply immersive experience.

This study explored valuable insights into the basis and applications of anamorphic screen art; however, it is essential to acknowledge its limitations. One of the major limitations of this study is that it is based on self-evaluation and technological analysis. By focusing on the technical execution of anamorphic effects within a controlled virtual environment, this study does not incorporate the direct viewers' feedback. In this respect, this already limits the capacity of the current study to evaluate audience perception and immersion from the illusions. Since the effectiveness of photorealistic anamorphic VFX often depends upon emotional and cognitive involvement on the part of the spectator, this remains an unresearched dimension of the current study.

Future research should address these limitations by integrating viewer studies testing the perceptual and emotional impact of anamorphic VFX. As discussed within the methodology, these types of studies might provide objective insights into how audiences engage with and become immersed, as opposed to the technical findings developed here. Testing these techniques would also allow them to be tested under realistic installation conditions, providing

valuable insights into their practical feasibility and effectiveness. Future studies can develop a more holistic approach toward anamorphic screen art by integrating technical, perceptual, and contextual analyses that create such impactful and immersive experiences.

Conclusion

Throughout this thesis, I explored how to synergistically combine photorealism and anamorphosis to enhance the immersive experience in visual storytelling. Using photorealism techniques, including detailed textures and accurate lighting, I developed the idea that real-world interactions should be reproduced. The principles of anamorphosis added a dynamic interaction layer to the visual narrative by predetermining the audiences' standpoints.

Through case studies and practical experiments, I identified key factors for creating successful anamorphic screen art, such as precise camera placement, advanced materials, and the use of HDRI-based lighting setups. However, the limitations that this study was based on virtual environments without actual feedback from audiences suggest the need for future research to assess the effectiveness of results. This study provides a framework for combining photorealism and anamorphosis into the evolving realm of VFX. It can lead to pathways for innovative applications in various fields, including advertising and interactive media. It is clear from these results that these techniques will offer an engaging visual experience by bridging the gap between realistic representation and artistic innovation.

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