Research on Aesthetic Features of Sci-Fi Cities in American Sci-Fi Animations

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Abstract. Science fiction is the experimental field of ideas, and the sci-fi city in animation is also the experimental field of future space. In the era of digital media, the sci-fi city scenes in 3D American sci-fi animation movies have become more exquisite and complex. American science fiction animation insists on building a future space with human civilization trajectory, and renews the aesthetic style of science fiction city with rich imagination, collage city style and powerful digital rendering capabilities. This article focuses on architectural modeling and city space in American 3D animation movies, and studies the sources of architectural inspiration and architectural design principles. And it also explores the new spatial form and new aesthetic characteristics of the science fiction city space under the digital technology.

1. Introduction

The sci-fi cities in the American sci-fi animation movies embodied the spatial presentation ability of 3D animation gradually strengthened under digital technology. From the architectural point of view, the inspiration for sci-fi architecture in the animation comes from realistic architectural thoughts. Most of the main buildings choose to design based on the design principles since the 20th century to pursue architectural forms that balance the futuristic and fantasy, and modern construct scene images that combine novelty and technology. From the city space point of view, American science fiction animation films uses powerful digital Image processing technology to build a complex and diverse building library to present urban space, and express the sense of refinement and technology of urban space as well as increasing entertainment. At the same time, American 3D animation movies create the novelty and strangeness of a science fiction city from the another way that constructs a collage-like urban style with adding multiple cultures elements to cater to the global consumer market. In addition, digital technology has updated the expression of different spaces in the science fiction animation city such as parallel universes based on quantum mechanics, chaotic universes and virtual cyberspace and etc., which enriches the image content of science fiction cities, and changes the way of watching animation movies.

2. Architectural Inspiration in American Science Fiction Animation

The architectural forms in American science fiction animation are ever-changing, and the imaginary of future architecture is often inextricably linked with the architectural style of the real world. In the early stages of animation production, the director will position the overall style of science fiction architecture in the works. For example, the art director Ralph Eggleston in Wall-E made it clear in the early stage of design that Anxiom, a space generation ship of human habitat, was inspired by the Tomorrowland of Disneyland, which is a response to Walt Disney ultramodern concepts in 1967[1]. In the design of Ito Ishioka Robotics Lab in Big Hero 6, the designer preliminary referenced to Santiago Calatrava, Renzo Piano, Takamatsu Shin and other architects’ architectural style. And the
design team is clear at the early stages that the appearance of San Fransokyo was the future city combination of San Francisco and Tokyo, etc. These pre-intentions all set the style direction for the architectural space form of American science fiction animation.

2.1. Inspiration Archetype One: New York and Manhattan Skyscrapers in The United States

It can be said that one of the oldest forms of science fiction city is vertical tall buildings. Since H. G. Wells' 1989 science fiction novel "When the Sleeper Awakes", the city has started to move into the future in a vertical form. Vertical cities that shoot straight up into the clouds are considered to be the future landscape extended by the current social paradigm. Manhattan in New York is one of the most typical visual image of the vertical cities, and the tall buildings in Manhattan such as the American Radiator Building, Chrysler Building and 30 Rockefeller Plaza in Art Deco style all represent futuristic style. The futuristic of the Art Deco style is reflected in their precise grasp of streamlined and straightforward rocket shapes. The New Urberm in The Incredibles 2 (2018) is also designed as a vertical city based on New York. In the film, the center of the city is still dotted with stark Art Deco steel-framed concrete buildings, and Bank of Municeberg adds the Art Deco style of radial decorations symbolizing sunlight on the mountain walls (Figure 1). In fact, the science fiction cities in American science fiction movies and Japanese animation are also inseparable from the inspiration of Manhattan city in New York. For example, the vertical city form of Coruscant in Star War were inspired by Manhattan, and the visual effects team pre-produced more than 2,000 CGI shots to show the matte texture of stainless steel similar to the Chrysler Building. The big city in Osamu Tezuka's Metropolis (《メトロポリス》2001) are extremely close to the Art Deco style by the architecture form that building blocks scaled down by height and the decorative patterns on building facade.

![Figure 1. The Skyscrapers and cities in Incredibles 2.](image)

2.2. Inspiration Archetype Two: Optimistic Futuristic Architectural Style

American science fiction animated films prefer to show optimistic futuristic architecture to build a warm, moving and family-friendly science fiction story. Therefore, it can be seen that American science fiction animated movies often feature many science fiction buildings based on optimistic futuristic architectural styles such as mid-century modern style and googie, which have a vibrant, enthusiastic and sunny atmosphere. Many of the buildings in The Incredibles 2 (2018) are inspired by mid-century modern style. One of the more important "home" buildings, Parr house, is a typical googie building (Figure 2). The upward-facing roof of Parr House is a reference to the 1963 James Evans house in New Canaan, and the hyperbolic parabolic roof of the house inspired designer Eggleston's design for the house's cantilever. This architectural modeling incorporates the concept of aviation and the universe into the design, making the residence look like a rocket taking off. The googie architectural design appeared frequently in the American 2D animation series The Flintstones (1963) and The Futurama (1999). The Axiom in Wall-E is also an optimistic futurism of the mobile city. Anthony Christov made it clear in the pre-design phase that he wanted to embed the technological optimism into Buy N Large, Inc.by architectural style, interior space and furniture design of the 1950s and 1960s, recreating the spirit of the era when "it was as if everything about the future could be done". From the appearance, Axiom is a kind of space dome city, and it highlights the great power of technology and technological optimism by the interior of a variety of leisure and entertainment mega mall complex and automated transportation system highlights.

In fact, Disney itself in reality is a cultural representative of futuristic and technological optimism. Disneylands are concentration spaces of optimistic futuristic buildings such as The Monsanto House

2.3. Architectures in Animation Follows the Design Principle That Form Should Consider Function

Although science fiction architecture in science fiction animation is fanciful, in fact, in American science fiction animation movies, architecture is often designed intentionally in accordance with certain design principles, rather than making groundless art creation just for the "sense of science fiction" and cool. For example, the final art plan of many animations is based on the aesthetic principle that form follows function. Designers strive to find a balance between crazy ideas and restrained forms, in an attempt to present a unique science fiction space with human civilization experience. In Big Hero 6, John Lasseter, the executive producer for Big Hero 6, insisted in the design process of the animated scenes that the designer should design the building to meet the function of the premise to integrate the original intention into the appearance of the building and build a credible structure and form[2]. Therefore, after iterating design, the designer Armand Serrano finally chose a more simple architectural form for his Expo Hall: the overall appearance is composed of geometric blocks, the shape highlights the simplicity of modernist architecture, the front is mainly made of glass, wood and marble, and the upward curved roof is a distortion of the simplified Japanese roof (Figure 3). Ito Ishiioka Robotics Lab was inspired by the glass architecture of Santiago Calatrava. and the robotics-themed building underwent an iterative design process from a figurative design that favored aerospace engines to a final, clean form. This final architectural shape continues the purpose of combining function and form, and its streamline shape expresses the characteristics of technological innovation. The high-rise DevTech at The Incredibles 2 (2018) uses geometry as the main building block, with stainless steel and glass curtain walls as the architectural texture and columns as support at the base of the building. This is the typical modern architectural form of Le Corbusie. And the interior of the building is open and spacious, focusing on creating a sense of fluid space, which is consistent with the formal requirements of architecture in the technological era that values space (Figure 4).

3. Urban aesthetic Features in American Science Fiction Animation

American science fiction animated films often tell stories with contemporary themes, such as stories about nature and the environment, stories about The growth of the protagonist., and stories about human precious emotions. Accordingly, in the style of science fiction cities, American science fiction animation films are mainly based on building bright and light dream cities, creating a more intimate and cozy future space. Compared to the heaviness, crime and oppression embedded in
traditional high-rise cities, the major architectural spaces in contemporary science fiction animated films tend to show a kind of translucency and brightness from structure to color, highlighting technology and novelty. By showing these bright, complex and highly interesting urban spaces, animations enhance the entertainment and spectacle of the films and respond to the theme of the stories.

3.1. Bright and Dreamy City Charm

The city of San Fransokyo in Big Hero6 gives the audience a general impression of being surrounded by technology, bright, translucent and brilliant. This impression comes not only from the color setting and light treatment of the city space, but also with the texture of the buildings and the layout of space in the city. The heart of the city is an area of glass skyscrapers. The concise geometry of the tall buildings and the light reflections of the metal and glass curtain walls highlight the technological and sunrise vibrancy of the city. The two bridges connecting the central area and the ocean both highlight the dreamy colors of the city: the blue bridge gives this urban space a cartoonishly cute atmosphere, while the red Golden Gate Bridge in the shape of Tottori adds a warm and soft sense of belonging to the city. The city of San Fransokyo has doubled both the topographic increase and the height of the buildings over the city of San Francisco. The twofold steepness of the landscape not only gives the city a unique three-dimensional and futuristic feel, but also allows the new skyline of the city to blend into the beautiful haze of San Francisco's clouds and early morning fog, which nicely expresses the warm ambiance of the city and the high-rise buildings. Krei Tech Industries building in Big Hero 6 was designed to be a white circular architecture like a rotating concentric circles with a kind of rounded transition with the ground. All of these features made this building appear round and gentle, reflecting the light and non-aggressive nature of technology. In Big Hero6, both the city scene and the character settings are echoed with San Fransokyo natural soft ideal city atmosphere, highlighting the warm dreamland symbolism surrounded by technology.

In Spider-man Into the Spider-Verse (2018), the places with the meaning of "home" are in warm colors of yellow, while the suburban laboratory is a light and transparent architectural space with a sense of technology and future. The high-rise DevTech building in The Credibles 2 is not a symbol of power for a group, but a transparent crystal palace stacked like playing cards and stretching high into the sky. It is a product of a perfect combination of technology and modern art. In addition, The Hydroliner, Fast Train station, Parr House all show the technology, dreaminess and incredible sense of the city in this animation.

3.2. Collage and Multicultural Fusion of Urban Style

The urban style of collage and displaying cultural fusion is an important style of the American sci-fi animated city. From the architectural design source, the exotic style architecture left behind in the colonial period developed and innovated the architecture in a collage and cultural fusion way. In terms of video, the American film Blade Runner explicitly brings the post-modern collage urban style to the science fiction videos, using the atmosphere of "decay"[3]to collage the characteristics of the eastern and western urban space into one.

Sci-fi animated films, like science fiction films, experiment with future spaces by collaging, combining old and new, and combining Eastern and Western multiculturalism. The eclectic City hall in The Incredibles 2 puts together a Greek-style foyer and a Roman-style dome pavilion. The parallel universe of Spider-Verse (2018) showcases diverse urban spaces, and the Miles Morales room highlights the Morales family's focus on multicultural education[4]. San Fransokyo in "Big Hero 6" is an outstanding futuristic city with the characteristics of collage and cultural integration, in which the Pan-American pyramid adds an upward curl to the prototype, making the whole look like a Japanese temple. The Cats Café perfectly blends the Victorian architecture of San Francisco with the Japanese style wooden houses and prominent Japanese roofs, and it also demonstrates the unique combination of San Francisco's idyllic tranquility and Japanese urban sophistication in San Fransokyo.

In contemporary times, American science fiction animation relies on digital technology to enhance the ability of animation to represent various spaces. First, American science fiction animation draw support from computer image processing system present more exquisite and complex urban spaces and update the way of showing the shots of urban spaces. Second, digital technology creates new aesthetic forms of space in the city, such as the aesthetic images of interfering parallel spaces and the aesthetic images of chaotic spaces. Third, digital technology makes cyberspace figurative. The embodied cyberspace can be seen as a new science fiction urban space. On the one hand, this urban space expresses the imagination of the digital age for virtual space. On the other hand, the embodied cyberspace is filled with virtual digital contents from various other works and video media. The virtual content and virtual culture make science fiction animation have more intertextuality with popular culture such as video games, animation itself and movies when representing cyberspace. These intertextualities in turn help animation use scenic images to mobilize viewers' engagement with the film and actively explore the film's narrative and space.

4.1. Under Digital Technology, Science Fiction Animation Film Updates the Performance Ability of Urban Space

Digital technology has expanded the ability of American science fiction animation films to represent urban space. First, animation using digital modeling can create a huge library of buildings and relies on powerful renderers to update the camera language that presents beautifully complex urban spaces. For example, with the help of Hyperion renderer, the visual effects team of Big Hero6 recreated 23 separate areas, 83,000 buildings in a high rendering display. Based on this, the animation was able to use "digital reconnaissance" to select shots and movement for the plot. As a result, the film was able to use the Great White Flight to travel through urban space to showcase San Fransokyo's sci-fi space with a mix of Pacific architecture and Japanese style.

Second, digital technology blurs the boundaries between 2D and 3D animation, presenting 3D urban spaces in the form of illustrations and comics. The artistic style of The Witness of Love, Death and Robot (2018) and Spider-man Into the Spider-Verse (2018) are the best caeses. Spider-man Into the Spider-Verse utilizes 2D processing on CGI keyframes to perfectly realize creating 2D illustration-style urban spaces with 3D software. The film simulates many impressionistic hand-drawn textures, and studies the simplification of multi-information urban space images as well as exploring the image hierarchy of complex urban space, and finally solves the problem of how to highlight the characters' actions in the rich illustrative space. The film used CMYK offset to show the effect of camera blur, simulating the form of motion expression in comic book performance. The animation combined speed lines and point perspective in comics to replace speed lines with structural lines in spatial composition, and made full use of urban space and camera space to build a comic-style sense of speed (Figure 5).

Figure 5. Spider-man into the Spider-Verse (2018) 3D animation relies on composition and software processing to simulate the speed line of comics and express the sense of movement.

4.2. Under Digital Technology, Science Fiction Animation Film Innovates the Aesthetic Form of Urban Different Space Under Quantum Theory

Sci-fi urban space is one of the best entrances to connect to different spaces such as higher dimensional space, quantum space or parallel universes in quantum theory. The digital image technology provides a new aesthetic form for science fiction works about opening the other-space and showing the chaotic space. spider-man Into the Spider-Verse uses digital technology to simulate
the visual effect of pulse interference, showing the fragmentation and overlapping of architecture and urban space caused by the space earthquake when multiple parallel universes interfere with each other. The film uses digital technology to successfully interpret the cubist style[5] with new faulty images of the folding and distortion of the city's otherworldly space. The Big Hero6 shows the alien space opened by the gas pedal and the chaotic state in it. This chaotic space is a space rendered by Mandelbulb, which is essentially a three-dimensional fractal image created from a spherical coordinate system[6]. Mandelbulb's complex forms without directionality, its three-dimensional combination and rich colors all make it become a better computer image to represent the chaotic space, otherworldly space and negative space in science fiction. The science fiction films "Doctor Strange", "Ant-Man" and "Annihilation" also use Mandelbulb to represent various other dimensions.

4.3. In the Age of Digital Media, The Figuration of Virtual Cyberspace and Intertextual Features of Virtual Content in Animated Films

Cyberspace composed of bits is a virtual space born in the development of digital technology. The cyberspace in the animation can be seen as a virtual form of urban space. Digital technology realizes the visualization of abstract cyberspace. For example, Wreck-It Ralph2 visualizes the infinite Internet space, and the spatial images of various website platforms are symbolic and metaphorical: Google is a transparent data mountain space, YouTube is a giant aerial multiplex cinema, its exterior resembles YouTube is a giant cathoderay tube television set[7]; Facebook is a cool spherical stage in the sky ...... Internet space is like an infinitely expanding, ever-changing, dynamic utopia of entertainment and consumption.

The thriving, complex cyberspace in Wreck-It Ralph2 is a side show of contemporary digital animation's growing capacity for accommodating video content. And digital technology has accelerated the speed of film narration, with fast-paced, high-volume video content directing the audience to actively communicate with the film[8]. Both Wreck-It Ralph2 (2018) and Ready Player One (2018) showcase a huge volume of digital virtual content in their works. This digital content includes a vast array of virtual digital characters and spaces from popular culture. These virtual contents frequently refer to each other in animation and film in a cross-media manner, demonstrating the frequent intertextuality and unique fluidity of digital virtual contents. The fluidity of digital content mobilizes the audience's motivation to watch the film. The animation director also intentionally transposes the cultural ecology of online social media and video games into the virtual space, and the audience is guided by the virtual image content and narrative framework, transferring the initiative for topic discussion and exploration of space and story to the animation work. In other words, digital technology not only materializes the abstract virtual cyberspace in a complex form, but also fills the virtual space with the rich digital virtual content it creates. This virtual urban space is covered by digital images and the cultural ecology it creates, which together form a new science fiction cultural ecology.

5. Conclusion

Contemporary American science fiction animated films tend to show optimistic future architectural style to build bright and transparent urban space. They use optimistic colors of bright cities to reflect contemporary themes such as environmental ecology, self-growth, love and care. Therefore, the architectural prototypes in American science fiction animation prefer optimistic future style architectural prototypes to build warm, transparent and cheerful dream future cities by using collage and fusion of multi-cultural style spatial approach. This kind of dream future city better fits the image tone of the moving family story.

Digital technology has enriched the image capacity of animated films, allowing the city to be displayed in a sophisticated and complex form in an all-round and multi-angle manner. At the same time, digital technology has created new spatial expression images such as fragmented urban space and Mandelbulb style chaotic space/microspace. The development of digital technology has brought about a boom in digital virtual content. On the one hand, digital technology brings the
materialization of virtual cyberspace and updates the aesthetic form of virtual urban space. On the one hand, digital technology allows animation to have an increasingly large image holding capacity. This is significantly manifested in cyberspace. The fluid digital content fills the virtual space of the network in animation as well as mobilizing cultural habits created by network culture such as active participation and spontaneous discussion into animation. The cyberspace in animated films constructs an alternative urban space and urban culture in the context of digital culture. This space is filled with pop culture images and cultural social habits created by contemporary digital technology, which complement the aesthetic expression of the science fiction city.

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