

# **Divers**

by

Paris Mavroidis

## **ABSTRACT**

*Divers* is a 3-minute 3D animation depicting a large-scale choreographed dive. It is an experimental piece which explores the abstraction of the human form into shape. The project also includes a set of custom animation tools developed for applying choreography to characters in the 3D graphics package Maya.

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Paris Mavroidis

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Paris Mavroidis

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Thesis Advisor – Claudia Tait

\_\_\_\_\_ Date \_\_\_\_\_

Chair – Peter Patchen

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## LIST OF ILLUSTRATIONS

### Figure

1. Stills from <i>Ballet Mécanique</i> (1924)	2
2. Stills from <i>Le Retour à la Raison</i> (1923)	2
3. Still from <i>Vormittagsspuk</i> (1928)	2
4. Still from <i>Anémic Cinéma</i> (1926)	2
5. Still from <i>Manhattan Cocktail</i> (1928)	3
6. Still from <i>Manhattan Cocktail</i> (1928)	3
7. Stills from Busby Berkley-directed dance sequences (1933-34)	5
8. Stills from <i>La Joie De Vivre</i> (1934)	5
9. Still from <i>The Big Lebowski</i> (1998)	7
10. Still from Chemical Brothers <i>Let Forever Be</i> Music Video (1999)	7
11. Still from <i>Olympia</i> (1938)	9
12. Still from <i>A State of Mind</i> (2003)	9
13. Still from <i>Baraka</i> (1993)	10
14. <i>Suspension</i> (2005), by Eric Zener	12
15. Character render by Renze Rispens	12
16. Swimsuit design from 1958	13
17. Modern swimsuit design	13

18. Still from <i>Harold and Maude</i> (1971)	13
19. Still from final animation	17
20. Still from final animation	18
21. Still from final animation	18
22. Still from final animation	18
23. Head model and joint placement	19
24. Choreography pipeline	20
25. User interface for the "Apply Clips to Characters" script	21
26. User interface for the "Keyframe Jitter" script	22

## TABLE OF CONTENTS

ACKNOWLEDGEMENTS.....	iv
LIST OF ILLUSTRATIONS.....	v
1. MASS CHOREOGRAPHY AND 3D ANIMATION.....	1
2. FINDING INSPIRATION.....	3
3. A LIGHTHANDED NARRATIVE.....	14
4. STYLISTIC CHOICES.....	16
5. TECHNICAL DETAILS.....	19
Modeling and Rigging .....	19
Custom Animation Tools .....	20
Effects.....	23
Rendering and Compositing.....	23
6. LOOKING BACK.....	25
REFERENCES .....	26
BIBLIOGRAPHY .....	27
FILMOGRAPHY .....	28
DVD: Animation.....	pocket
Data CD: Source Code and Documentation.....	pocket

## CHAPTER 1

### MASS CHOREOGRAPHY AND 3D ANIMATION

The idea for this project stemmed primarily from my interest in the visual aesthetic of large-scale choreography. Whether seen in performance, sport or religious ritual, a mass of people moving together in a singular fashion has an awe-inspiring and unsettling effect. Individual bodies lose their recognizability and become shapes. Participants lose their visual identity as they become part of a larger entity, which in turn takes on a life and movement of its own.

I thought this would be an interesting area to explore within the realm of 3D animation for a few reasons. Firstly, the medium of animation lends itself to outlandish and unrealistic situations, which could serve one of the main purposes of mass choreography: spectacle. Secondly, the computational and programmable nature of 3D graphics opened the possibility to experiment with different formations and choreographies in an easy and automated way, provided the right software and user interface existed. As both an animator and a programmer, I thought it would be challenging and useful to try and develop a set of choreography-based animation tools that were both powerful and accessible to an artist.

From this starting point, I began formulating a more concrete idea of my project. It would include the development of custom choreography scripts and

also a short animation which takes advantage of the boundless nature of the medium. In conceiving of my animation's content, an important starting point for me was American and European cinema during the 1920s and '30s, a time period marked by important cinematographic innovations and also one that saw some early and notable instances of large-scale choreography on film. I saw an interesting opportunity to create an animation which juxtaposes the style of an older era in film with the relatively new medium of digital animation, which is often associated with futurism.



Fig. 1 - Stills from *Ballet Mécanique* (1924), directed by Fernand Léger and Dudley Murphy



Fig. 3 - Still from *Vormittagsspuk* (1928), directed by Hans Richter

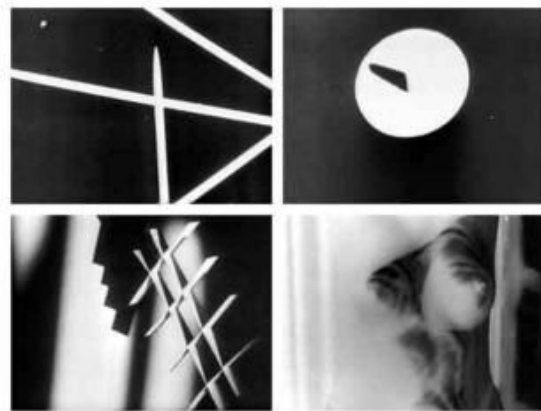


Fig. 2 - Stills from *Le Retour à la Raison* (1923), directed by Man Ray

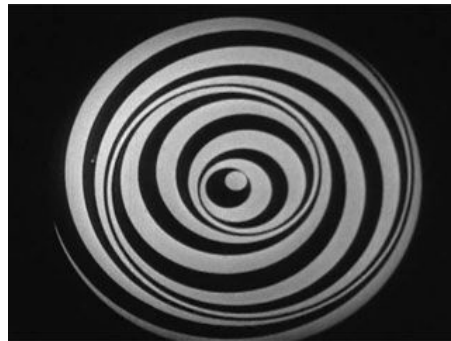


Fig. 4 - Still from *Anémic Cinéma* (1926), directed by Marcel Duchamp

## CHAPTER 2

### FINDING INSPIRATION

The 1920s in Europe were a fertile and defining period for avant-garde and experimental filmmaking. During this decade, artists such as Man Ray, Dudley Murphy and Marcel Duchamp (see Figures 1, 2 and 4) created non-narrative works that are now considered canonical in the history of film.<sup>1</sup> They approached the medium from an abstract vantage point, highlighting the rhythm of editing and the expressiveness of shape and composition, in place of narrative and representational content. It was not long before the techniques and aesthetics of these forward-thinking works began to be incorporated into mainstream cinema. Slavko Vorkapic's abstract montage sequences for movies such as *Manhattan Cocktail* are a good example (see Figures 5 and 6) .



Fig. 5 - Still from *Manhattan Cocktail* (1928).  
Sequence directed by Slavko Vorkapic.



Fig. 6 - Still from *Manhattan Cocktail* (1928).  
Sequence directed by Slavko Vorkapic.

By the 1930s, the infiltration of abstract imagery and avant-garde techniques into mainstream movies was likely being spurred on by the economic climate of the time. The effect of the Great Depression on American cinema can be summed up as one of escapism coupled with introspection and gloominess.

Cultural historian Thomas Doherty describes this effect:

From sin to retribution, debauchery to convalescence, gaiety to gloom, the “morning after” imagery and moral shadings of the historical shift settled over the atmospherics of Hollywood cinema. Wild party scenes fade to wasted flappers passed out on sofas; tires screech as drunken frat boys in speeding flivvers miss the curve; frenzied trading on Wall Street dissolves to piles of ticker tape swept up in trash bins.<sup>2</sup>

Film critic Mick LaSalle looks specifically to the Warner Brothers musicals of the 1930s to find a tone representative of the era:

Today, when thinking of supposedly escapist Depression-era entertainment, some might picture the classic opening to *Gold Diggers of 1933*, with Ginger Rogers leading a scantily clad Busby Berkeley chorus line in the song *We're in the Money*. Indeed, the scene does exemplify the era, though to understand its spirit, you have to remember how the number ends: A sheriff enters and closes down the dress rehearsal because the producers have gone broke.<sup>3</sup>

“Pettin' in the Park”, another musical number from the same film, indicates “the movie's dual focus on fiscal troubles and carnality,” according to film critic Lucia Bozzola.<sup>4</sup> The seductive, fanciful and overindulgent musical numbers that Busby Berkeley staged can thus be seen as a counterpoint to and escape from the economically downtrodden settings of the films they inhabited. This coupling is also present in other works of the era, such as the 1934 animation *La Joie de Vivre* by Anthony Gross and Hector Hoppin. The action presented in this work is

high-spirited and escapist, but is often juxtaposed with settings that are industrial and grim in appearance (see Figure 8).

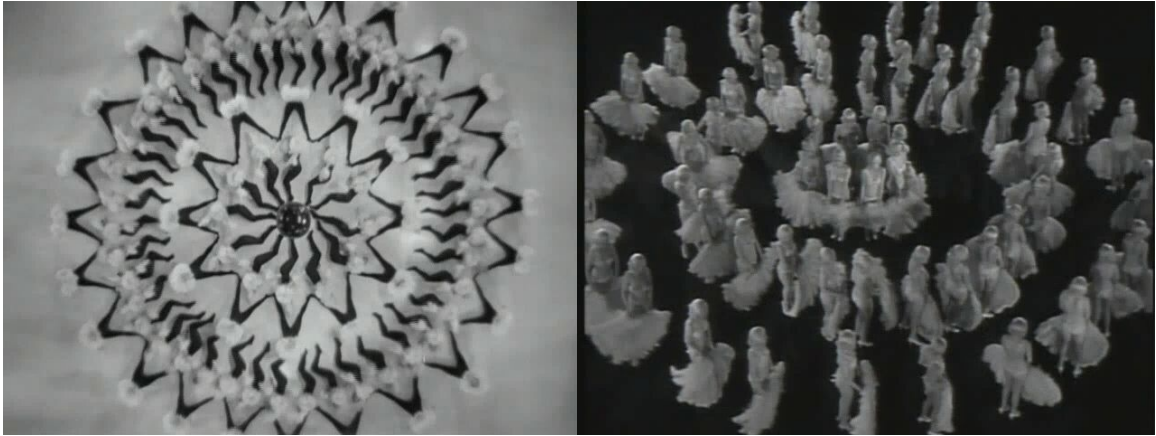


Fig. 7 - Stills from Busby Berkeley-directed dance sequences (1933-34)

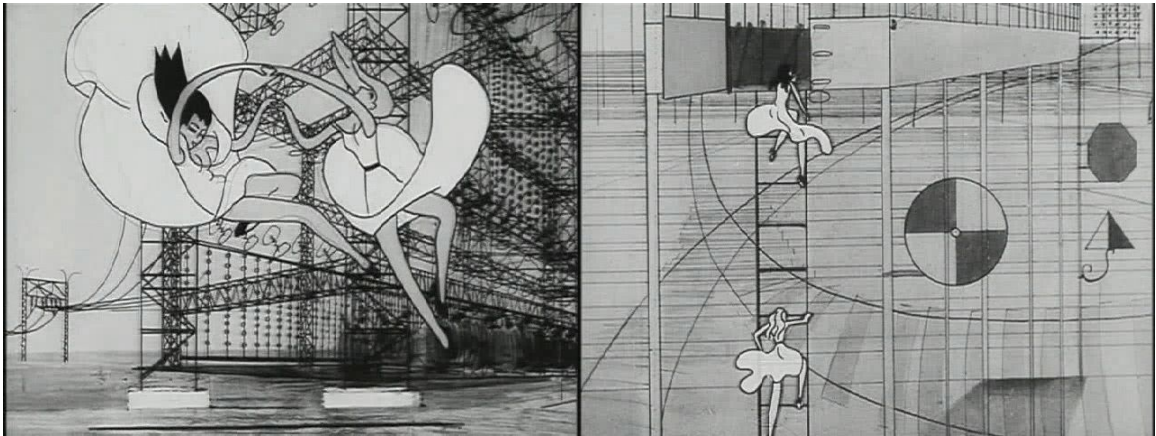


Fig. 8 - Stills from *La Joie De Vivre* (1934), directed by Anthony Gross and Hector Hoppin

Berkeley's sensational choreographed numbers are a key example of the cross-fertilization between experimental and commercial film. They exhibited a surrealism and an innovative exploration of shape and cinematography that were not common in most Hollywood films. Martin Rubin writes that “historians

frequently relate Berkeley's film style not to any stage tradition but to the avant-garde, abstract and surreal traditions of non-narrative cinema.”<sup>5</sup> While the plots of these musicals were admittedly conventional (the plot summary on the packaging of a recent re-release of *Gold Diggers of 1935* invites the viewer to “repeat Screenwriting 101 class if you can't see where *that* leads”<sup>6</sup>), the dance sequences are regarded highly enough by film historians to be included in avant-garde film collections (as a scene from *Wonder Bar* recently was, with notable archivist and curator Bruce Posner introducing it as a “monumental abstract ballet.”<sup>7</sup>)

In 1968, film critic Andrew Sarris wrote that “Berkeley's contributions deserve better than being consigned to the sniggerings of Camp followers. Busby Berkeley deserves enduring respect as the Melies of the Musical.”<sup>8</sup> Berkeley's far-reaching influence can be recognized in a myriad of modern movies, animations and music videos, but references to his choreography in contemporary popular media are often very direct and tend to play up the campy and clichéd associations of his work. Some examples include a dream sequence from 1998 film *The Big Lebowski* (Figure 9) and a 1999 music video for a Chemical Brothers song (Figure 10).



Fig. 9 - Still from *The Big Lebowski* (1998), directed by Joel Coen



Fig. 10 - Still from Chemical Brothers *Let Forever Be* Music Video (1999), directed by Michel Gondry

Berkeley's choreography and cinematography were a strong visual influence on my thesis idea, and I wanted my animation to highlight their artistic and experimental nature. I thus envisioned a piece that would acknowledge the link between Busby Berkeley and avant-garde film of the early 20<sup>th</sup> century, while steering clear of frivolity and silliness.

Mark Roth believes that the escapism of Busby Berkeley sequences is acting in service of a symbolic and political function. Viewed through a practical rather than an emotional lens, the dancing takes on a collectivist and ritualistic quality:

But rather than being 'escapist' in any sense it seems to me that the great Warners musicals are essentially political. Basic to the collectivist nature of these musicals is their ritualized form. The quintessential symbol is the Berkeley dance number. The urge of the dances and the film is towards cooperation and collective effort. Individually, Berkeley's dancers would amount to little... But when he has them working together, each atomic unit contributes to an effect larger than perhaps any of them could imagine... It takes only a little imagination to see Berkeley's stars and flowers and circles as symbols of an harmonious nation. Not

of course the nation as it was in 1933, but the nation as millions believed and millions more hoped it could be.<sup>9</sup>

Roth's sentiments draw a parallel between Berkeley's dance numbers and the more conspicuously propagandistic choreography often associated with totalitarian indoctrination or nationalistic pride. Artist Lynne Marsh recognizes this effect in Leni Riefentahl's 1938 documentary *Olympia*, a technically and aesthetically superb film which many consider to bear the mark of Nazi propaganda:

In Leni Riefenstahl's epic documentary *Olympia*, she has filmed mass displays of exercise and gymnastics during the 1936 Olympics. Filmed from an omnipotent perspective, the camera reveals a vast number of bodies participating in rhythmic displays on an awesome scale. There is an overwhelming sense of a superior force lurking in the background and manifested in the spectacle. The individual identities are vanquished to the greater collective formation/machine.<sup>10</sup>

This can be seen as early cinematic evidence of the unifying power of large-scale choreography (see Figure 11), a phenomenon which still persists. The 2003 film *A State of Mind*, which documents mass gymnastics in North Korea, specifically explores mass choreography as a tool for political assimilation for both the participant and the viewer (see Figure 12). North Korean leader Kim Jong Il is quoted as saying that “developing mass games is important in training schoolchildren to be fully developed communist people,” while a young girl training as a gymnast for this event says that in the course of the training “group power develops and individualism completely disappears.”<sup>11</sup> The impressive opening and closing ceremonies of the 2008 Beijing Olympics showed a similar

emphasis on the unity of masses. In an account of the opening ceremony, film critic Roger Ebert sees similarities to another Riefenstahl-directed propaganda film:

The sheer size of the production was awesome. It said a lot for China, both positively and perhaps negatively... the emphasis was not on individuals, but on masses of performers, meticulously trained and coordinated... the closest sight I have seen to Friday night's spectacle, and I mean this objectively, not with disrespect, is the sight of all those Germans marching wave upon wave before Hitler in *Triumph of the Will*.<sup>12</sup>



Fig. 11 - Still from *Olympia* (1938), directed by Leni Riefenstahl



Fig. 12 - Still from *A State of Mind* (2003), directed by Daniel Gordon

Similarly, many of the dances found in religious or tribal ceremonies exhibit blocking and movements that enforce the idea of unity. The 1993 documentary *Baraka* includes some striking footage of the way choreography plays out in the context of religious ritual in its capturing of a group performing the Hindu “Monkey Dance” (see Figure 13). Elias Canetti describes the “throbbing crowd” seen in the haka dance of the Maoris in New Zealand as “a creature with fifty heads and a hundred legs and arms, all performing in exactly

the same way and with the same purpose. When their excitement is at its height, these people really feel as one.”<sup>13</sup>

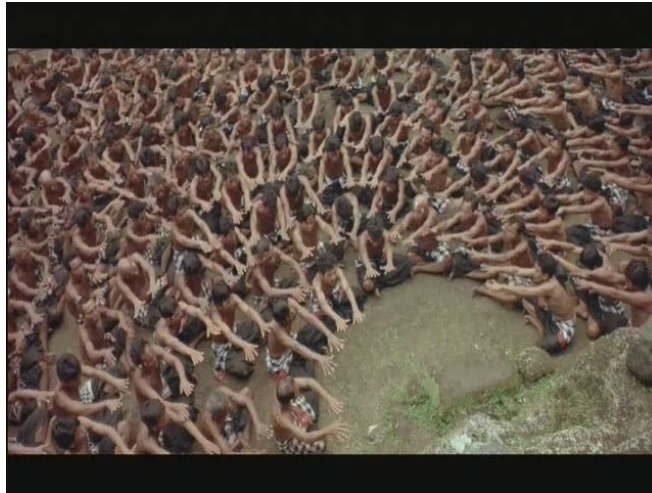


Fig. 13 - Still from *Baraka* (1993), directed by Ron Fricke

All of the aforementioned works informed my idea to depict a choreographed dive that has been scaled up to an impossible size, both in terms of height and number of participants. In the most general sense, I wanted my animation to draw from the emphasis of avant-garde cinema on shape, abstraction, visual rhythm and the surreal. In terms of cinematography, I was influenced by the way that *Olympia* effectively highlights the beauty of the human body and the drama inherent in athletic movement. I was drawn to the freewheeling and expressive way the dancers in *La Joie de Vivre* moved and I was inspired by the way that the spiraling, angled patterns which Berkeley formed with his dancers were mathematical and precise, yet organic in their reflection of the symmetry found in the natural world. To address the connotations of mass

coordinated movement with assimilation and conformity, I saw an opportunity to subtly draw a distinction between the individual diver and the group that absorbs her for the duration of the dive.

As additional references for motion and choreography, I examined video footage and photographs from sports such as synchronized swimming, synchronized skating, choreographed gymnastics, skydiving, synchronized diving and springboard diving. There were similarities between the formations and techniques employed in many of these sports, such as offset movement, intersecting line formations and spinning circular formations. Another important technique is the grouping shift which occurs through the linking and unlinking of the athletes. In synchronized sport, as in dance, the precision of both the positioning and timing of every member of the group is an essential aspect of the performance.

Although skydiving theoretically opens up the possibility of three dimensional formations, the shapes formed by large groups of skydivers are typically planar and do not change over time. This is due to the difficulty inherent in maneuvering and holding certain group positions against strong wind resistance. Thus, the movements in my animation would have to bend the rules of physics in order to be rendered visually engaging and expressive.

Another strong stylistic and artistic influence on my project was the work of painter Eric Zener, who primarily paints serene and introspective portraits of people swimming or diving (see Figure 14). The palette he uses and the dramatic way he poses his characters were both important reference points. In choosing a

direction for the rendering style of my character, I looked for 3D work which employed a simplified and softened take on realistic shading. Examples included the 3D stills created by Marc Tan, Renze Rispens (see Figure 15), and Arid Wiro.



Fig. 14 - *Suspension* (2005), by Eric Zener



Fig. 15 - Character render by Renze Rispens

Finally, for the design of the diver's costume, I looked at swimsuits worn by women between the 30's and 50's (Figure 16) as well as more contemporary designs (Figure 17) , in an attempt to combine a classic, leisurely style with a modern and sporty one. The swim cap design was inspired by a cap I saw a character wearing in the movie *Harold and Maude* (Figure 18). I reworked the petals to make them larger and less sharp, giving the cap a more floral and appealing look.



Fig. 16 - Swimsuit design from 1958  
(Condé Nast Archive/Corbis)

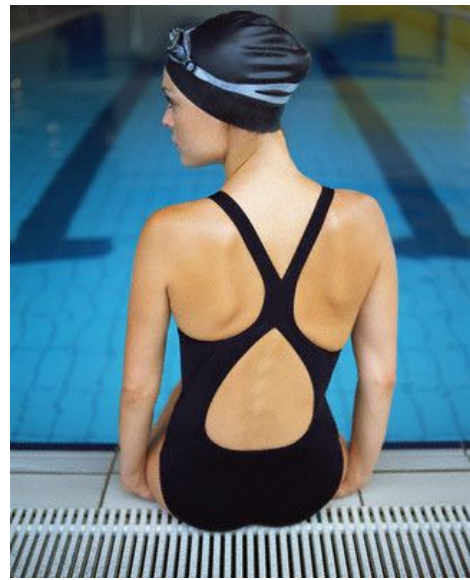


Fig. 17 - Modern swimsuit design  
(Corbis)



Fig. 18 - Still from *Harold and Maude* (1971), directed by Hal Ashby

## CHAPTER 3

### A LIGHTHANDED NARRATIVE

One of my main concerns in planning the action of my animation was striking an appropriate balance between the narrative and the visual aspects of the piece. My intent was to create a piece that was chiefly experimental and tonal, while still containing a faint narrative arc that provided some tension and momentum.

The action of the animation unfolds relatively slowly and builds up to a climax. It begins with a single diver walking up to a diving board, with the lengthiness of her preparation building some suspense. When she finally jumps and it's revealed that she is diving from a great height, more than half a minute has passed. Another development follows shortly, as more divers become visible. The choreography that ensues builds up as more and more divers become involved and escalates as they pass through clouds and approach the ocean. Finally, the tension of falling is broken as they enter the water. The final shot shows a diver who floats in the water and regards a row of tall staircases that her fellow divers are already beginning to climb.

The denouement lends a cyclical nature to the action and also bookends the piece by returning the vantage point to a single diver. I saw this as a way to highlight the contrast between the individual diver and the group that she surrenders herself to. The imposing staircases that lead back up to the diving

boards can be viewed as another aspect of the fantastical world that the animation inhabits, but there is also a suggestion that the experience of climbing them is somewhat cruel and that an individually-minded diver may choose to opt out of the whole process.

## CHAPTER 4

### STYLISTIC CHOICES

By offering a counterpoint to the flamboyant and seductive tone that is usually associated with large-scale choreography, I hoped to offer a unique aesthetic in my piece. I intended to highlight the visual aspect of the animation by intentionally downplaying the emotional associations it may have. Thus, the surrealistic and outlandish bent of the content and the expressive feel of the movement was balanced by a level-headed delivery.

I chose music which contributed strongly to the pacing and buildup of the piece, but exuded a calm and detached tone rather than the grandiose soundtrack which may usually accompany a similar choreographed sequence in film. Similarly, I gave the divers natural facial expressions which are focused, subtle and composed. This distances the piece from associations with the thrill-seeking of skydiving or the enthusiastic and smiling performances often seen in filmed choreography. It also reflects the idea of the athlete eschewing emotion in favor of technique and precision. This cool approach suits the piece better than an emotional one because it highlights the beauty of the visuals while asserting that there is indeed something cold in the depersonalization that takes place in mass choreography. This impersonality is also reinforced by the divers' identical costumes and appearance.

I strove to keep the cinematography of the piece simple and effective. In contrast to a lot of kinetic and action-based filmmaking, I eschewed fast cuts and shaky camera movements. I wanted viewers to have time to focus on how the action unfolds and on the patterns that form in the choreography, without being rushed into the next shot. This deliberate and steady pacing resulted in the 3-minute piece being spread out across only ten shots. When I could, I would combine two shots into one and have the spatial relationship between the camera and divers change over the course of time, rather than as a result of a cut. What was lost in terms of urgency and momentum was gained by presenting a more abundant and substantial visual experience that rewards patient and discerning viewers.

For the overall visual style, I wanted to let the characters stand out by keeping the backdrops relatively muted. I also tried to employ a variety of camera angles and compositions. Figures 19 and 20 show a close-up and a medium shot respectively. Figure 22 shows a long shot which has a strongly symmetrical composition, while Figure 21 is an example of a more off-center composition.



Fig. 19 - Still from final animation



Fig. 20 - Still from final animation



Fig. 21 - Still from final animation



Fig. 22 - Still from final animation

## CHAPTER 5

### TECHNICAL DETAILS

#### **Modeling and Rigging**

The 3D application I used for my project was Maya. When modeling the character, I tried to keep the geometry as minimal as possible, so that scenes would be less heavy during the animation process. For the character rig, I used the auto-rig application *Setup Machine* for the general body controls. I combined this with my own controls for the jaw, eyelids, hat petals and goggles. For facial controls, I incorporated the *Facial Animation Toolset* into the rest of the rig. This is an automated facial setup which drives facial regions with joints and prerecorded motion data. I maintained two versions of the rig: one version had high-resolution textures and a facial setup (and was used only for close-up shots), while the other had low-resolution textures and no facial rig.

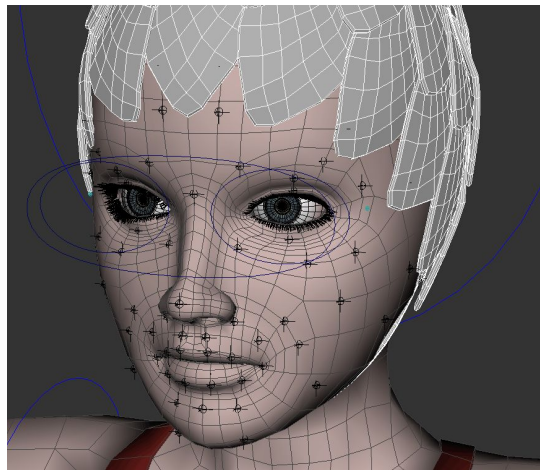


Fig. 23 - Head model and joint placement

## Custom Animation Tools

One of the primary challenges of this project was to manage and animate the large number of characters in a given shot. Not only can this become very time consuming, but it can also result in heavy scenes which bog down the computer's resources. I alleviated the computational heaviness of the scenes by making the majority of the characters geometric instances of a smaller group of rigged characters. These rigged characters were animated non-linearly, through the application of animation clips. A second layer of animation acted upon the translations and rotations of these instanced geometries.

I developed three MEL scripts and accompanying user interfaces to help me automate the aforementioned process. They are numbered 1-3 in the following diagram:

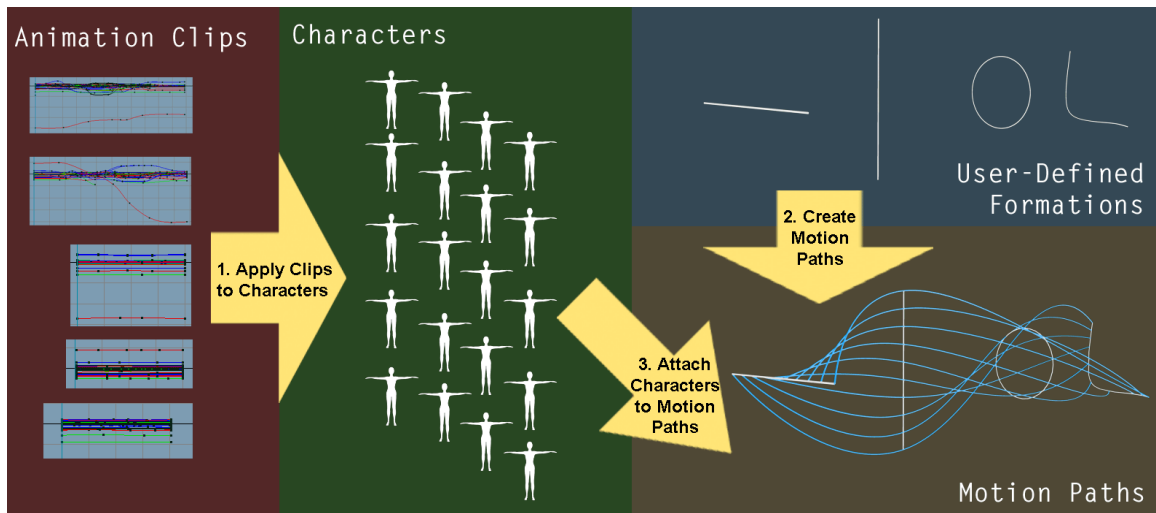


Fig. 24 - Choreography pipeline

The first script allows the animator to apply animation clips from a source character to many target characters at once. The same clips can be made to vary

from character to character in terms of when they start and end, the variance in their speed over time and the scale by which they affect movement.

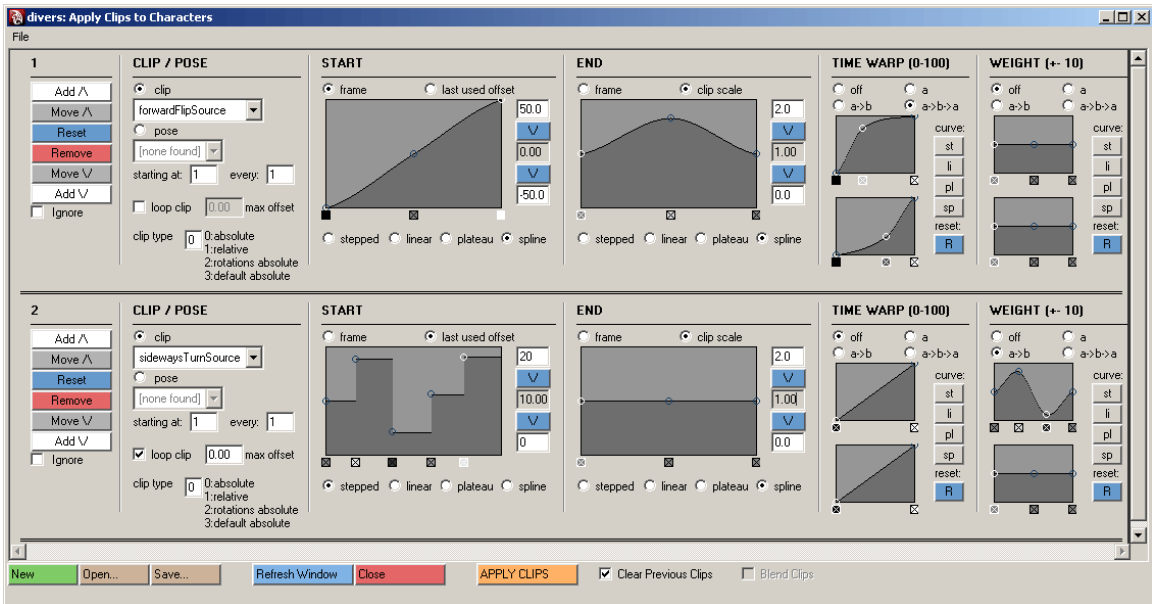


Fig. 25 - User interface for the "Apply Clips to Characters" script

The second script is used to create motion paths from either a nurbs surface or a series of curves which specify the formation of the characters in space at a given point in time. The third script allows the animator to attach multiple characters to multiple motion paths simultaneously, while controlling at what velocity each character is traveling down its specific path at a given point in time.

For certain shots, the second and third parts of pipeline were instead handled by a particle system, with the geometric instances of the character attached to individual particles. The particle instancer in Maya allowed me to control how the instanced geometries behaved based on factors such as velocity, acceleration and position within the particle system.

I created one additional script during the animation process called “Keyframe Jitter,” which automatically applies random animation to a given attribute over time. I used this to animate the overall position of the divers while they were falling, to give the impression of wind resistance moving them in a random manner. I also used it to animate the divers' hat petals, to quickly simulate the way wind might move them.

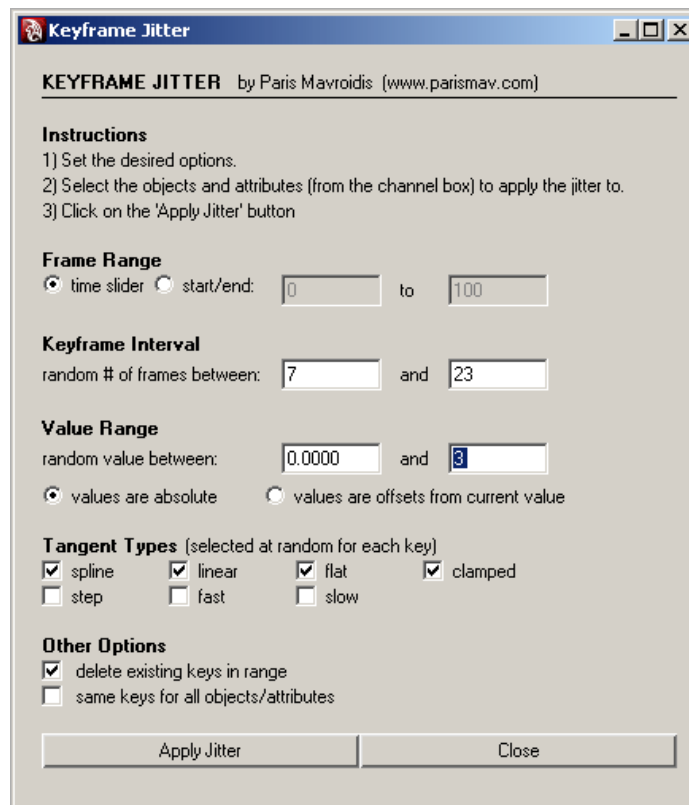


Fig. 26 - User interface for "Keyframe Jitter" script

For in-depth documentation of these custom animation tools, as well as all the source code, please consult the included data CD.

## **Effects**

Another important technical aspect of the project was special effects such as water and clouds. Both the surface of the water and the clouds were rendered using maya fluid effects, which allowed for a considerable amount of flexibility in terms of how these phenomena look and move. The underwater shot was realized using particles to simulate bubbles and foam.

## **Rendering and Compositing**

I rendered each shot in several separate layers, in order to give myself the maximum amount of control over the look during the compositing stage, which was done in After Effects. For most shots, the render layers that were came out of Maya were as follows:

- 1) *Color pass* – This included diffuse illumination, color, specular and reflections.
- 2) *Ambient occlusion* – This was used to simulate the darkening of areas where light would be occluded.
- 3) *Depth map* – This was used to apply depth of field and sky fog effects.
- 4) *Motion vectors* – this was used to apply motion blur in post.
- 5) *Sky* – this layer consisted only of the sky color, without

any clouds.

- 6) *Passing clouds* – these were clouds that would quickly pass as the divers were falling. This pass itself was usually split into two, to separate clouds that are far away from the camera and the closer ones that appear between the camera and the divers.
- 7) *Motion tracking* – this consisted of a low-quality render of some strategically placed tracking points in the shot, which would be used to track the camera and translate its movements into 2d space. The resulting tracking info was used to place 2d background clouds into the scene in the compositing stage.

Some shots were difficult to render because the amount of characters in the scene would cause memory to run out. In these cases, I rendered different depths separately and combined them in After Effects. In the compositing stage, all the layers were brought together and the aforementioned effects were applied. I then implemented overall effects, such as color-correction, grain and vignetting, to give the piece an organic and unified look.

## **CHAPTER 6**

### **LOOKING BACK**

This project was the largest in scope I have ever worked on and was also the first time I attempted to choreograph something. While I didn't run into any major production obstacles, there were still times that the rhythm of my workflow was impeded due to the heavy scene files I was working with. Ultimately, it may have been a good idea to have found someone to collaborate with at the outset of the project. The combination of both programming and animation made this project relatively time-consuming and also an ideal one to split up between two people, with one person focusing more on the technical aspects and the other focusing on the creative ones. Regardless, the process of undertaking all of this was an interesting and challenging one and I felt satisfied with the final product. In the future, I hope to continue exploring 3D animation as a medium for both filmmaking and creating tools for other artists to use.

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