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Inkling: An Exploration of Visual Effects as a Character

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INKLING:
AN EXPLORATION OF VISUAL EFFECTS AS A CHARACTER

by

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ABSTRACT

Inkling is an animated short film about a creature made of ink falling into a cycle of anxiety. This film explores the use of visual effects in character design. Inspiration for this film was drawn from Absurdist essays and stories and used abstract imagery and cinematic devices to manipulate the audience into feeling the character's anxiety. This thesis briefly examines the foundation of methods pioneered by visual effect artists. To produce this short film, critical decisions in software and animation were made to streamline the process to allow more time to focus on creating a method for the visual effect of the character. *Inkling* is a culmination of different simulation methods, pipeline processes, and research methods to create a character made of fluids.

To view the film, click here: https://youtu.be/tnFVIMssJaI

ACKNOWLEDGMENTS

I would like to thank Jason Mayor for guidance on fluid Dynamics in Houdini

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CHAPTER ONE: INTRODUCTION

From the beginning of film as an artistic medium, artists have sought to manipulate the picture to their perception whether through trick photography or practical effects like smoke machines. These visual effects immersed audiences into the world the artists imagined. Visual effects were used as a tool to create an atmosphere around the subject matter or used in a way to bring new possibilities together like a man walking with dinosaurs. Technology has always served as a limiting factor to what an artist could achieve with visual effects. Pioneering filmmakers like James Cameron and George Lucas have embraced the necessity to challenge the limits of the existing technology to realize their artistic imagination for the worlds they want to bring to the big screen by inventing new technology to realize their visions ("Master of FX" 10). One of the most memorable scenes in film history demonstrating this phenomenon occurred in 1989's *The Abyss* when the audience first experienced a character made of water staring back at one of the film's stars. With the advancements of computer integration into visual effects production, software applications and technology have evolved allowing these operations to be more approachable for artists to create worlds that no one has seen before. In the new era of this emergent field, no longer are visual effects only used as atmospheric tools to help the setting in the story. However, with technological advances, these visual effects have become a focal point at the forefront of modern storytelling.

Technology and tools have become more sophisticated in the visual effects space, allowing characters to be made entirely of digitally simulated elements. With this new visual process, stories from absurdism and existentialism lend themselves well to the animated medium.

The short film, *Inkling*, explores the possibilities of how visual effects can be leveraged in storytelling when a character is derived solely from fluids. Heavily influenced by personal experience, the metaphorical imagery is an absurdist perspective on the emotional challenges I faced while returning from medical leave after battling cancer. The fluid effects help elaborate the character's emotions, mainly because the fluid character, Inkling, has no facial features. A pipeline was created by using captured data from motion capture sessions and importing that data into SideFX's Houdini environment. Throughout the history of filmmaking, visual effects have always been secondary to characters, stories, and locations. Now, because of the ability to create highly dense simulations, artists can create incredible detail in characters made entirely of dynamic simulations.

CHAPTER TWO: THE HISTORY OF FLUID DYNAMICS

Images have always captivated the human imagination creating a need for effects to help ground film in a believable reality. During the Renaissance, there was a resurgence of visual arts leading to the first developments of early camera technology. Richard Rickkit writes, “A popular attraction during the Renaissance was the camera obscura (meaning ‘Dark room’)” (8). Attendees would gather in this dark room to see moving images of the world outside. Their fascination would continue, and the art of filmmaking would begin. George Melies, the father of special effects, created a film in 1902 titled *A Trip to the Moon* that captivated his audience with smoke and double exposure for the first time. As the art of filmmaking grew and matured, it transformed the industry; special effect techniques became far more sophisticated.

The 1920s American films flowered when filmmakers pioneered traveling matte processes, scaled models, and stop-motion photography(Rickitt 18). These advancements helped suspend disbelief. The principles and techniques that filmmaking pioneers created are still being utilized today. This paved the way for future filmmakers like myself to create a story like *Inkling*. The way we edit and the tools to add visual and audio effects may have changed, but the principals are still the same. Visual effects artists regularly pushed the boundaries of what is possible to create effects like what is seen in *The Blob.*

The film *The Blob*, released in 1958, featured the first character made from fluid. Utilizing many of the aforementioned practical effects, the filmmakers relied heavily on modeled sets and stop-motion photography to bring the liquid alien to life. The character the Blob squeezes through the vents of buildings, flows through hallways, and absorbs humans.

Interactions between actors and the alien were often the result of close-ups and manipulated slime or silicone props, (Johnson 22) This was the first time an audience would see a fluid character. This film would go on to help inspire filmmakers, like the makers of *Monsters vs Aliens* and *Hotel Transylvania*, that would later inspire me. I really wanted to make my animation morph and form into a character like the Blob.

The Abyss was a groundbreaking film for its time. One of the stunning effects is the water effect that interacts with Mary Elizabeth Mastrantonio. In the scene, the actress is looking at a water tentacle. As she looks at it, the water tentacle forms into her face to stare back at the actress. Ian Failes writes, "One of the common questions asked of the visual effects supervisors is 'How are we going to do this effect?' That challenge was presented by James Cameron to Bruno for the water tentacle creature." (16) With the advances in digital tools and technology, the visual effects supervisors and Industrial Light and Magic began exploring and creating digital characters. They began the early exploration of creating visually stunning characters which could only be done in a virtual atmosphere and then composited with the film plates. At the time, the artists were using a piece of software called Alias. This software later evolved into Wavefront and Maya. Industrial Light and Magic use the software to create the original Pseudopod test for the film. Without the aid of this software this effect for the film would have been made with practical effects and felt out place.

Terminator 2 also took some significant steps in visual effects with the T-1000. The ILM team devised an ingenious way to capture Robert Patrick's movements. They painted a grid on his body and recorded his movements simultaneously from the side and the front. They used that data to create digital versions of his movement. They found a way to capture his movements

before motion-capture technology was created. The ILM team even had to correct some original animations. Steve Williams is quoted saying, "We even originally included a limp Robert had from a football injury. I noticed it in the initial test that we shot with him. So, I had to try and correct that in the bone walk" (“Terminator 2”). Heavily influenced by the ILM teams early work, *Inkling's* animation is also based on the performance of a motion capture actor. The data captured from the motion capture studio was used to create the animation. This process also led to bad data, either from a marker falling off or just not having any animation there, like the fingers. In *Terminator 2*, they had to overcome many hurdles like the reflective surface, the character morphing from a blob into a human form. ILM used tools they created from their work on *The Abyss* to aid them in the process of the film. In an interview with Ian Failes Jonathan French states," For the healing shots, John Schlag wrote this great utility harvested from *The Abyss*, which I think he/we called Z-ripple”(“Terminator 2”). Through the dynamic simulation, Inkling would also have ripples. This was achieved by allowing certain particles in the simulation to die and new particles to replace them.

Moving to Disney influences, another live-action film that had a fluid gelatinous character who morphed was *Flubber*. ILM was again tasked with trying to solve numerous technical issues like the character texture/material and the way the character would be able to morph in the shots. They used tools like Softimage and some proprietary software to create the look of Flubber. "ILM did use, for one of the first times in film production, Mental Ray, which gave physically-accurate refraction through Flubber (unlike RenderMan at the time, which 'faked' it) but it was very computationally-intensive, so it was used sparingly and only for hero flubbers" (“Flubber”). Renderman now uses raytracing which helps create physically accurate

lighting. For my film I used Renderman, which allowed for the artistic control of lighting and shaders. Most renders today have the ability to use HDRI image which creates physically accurate lighting that matches virtual setting to live actors.

Animation

While practical effects are grounded in what is real, animation is limited only by imagination. The 20th century saw massive growth in the animation industry. Emile Cohl, a master of many art forms, was a pioneer in the field of animation. Maureen Furniss writes, “Cohl met many other artists, and during the 1880s, he associated himself with a group called the Incoherents that valued absurdist concepts and dream imagery” (39). The film *Fantasmagorie* showcases imagery and absurdist concepts. I learned about Emile Cohl while working on my thesis. The style of storytelling intrigued my curiosity, and it allowed me to really look at what the absurdist concepts were. The character fluidly transforms into the next object progressing the short film as if we are see many different stories that are all connected through the clown character.

Walt Disney Studios' patented invention, the multiplane camera, allowed animators to create a parallax while filming. Parallax is the illusion that cameras produce where images in the foreground appear to move quicker than the background. This gave the background the illusion of depth for Disney's feature-length films like *Snow White*, *Pinocchio*, and *Bambi* (Furniss 105). The studio would also push the development of hand-drawn effects like that of water, as demonstrated in animated films such as *Fantasia*. *Fantasia* showcased Disney’s prowess in effects and the ability to create visually dynamic stories linked directly to how Leopold

Stokowski conducted the orchestra. This segment of the film, set to Pyotr Tchaikovsky's *Nutcracker,* showcases a fully realized underwater scene with a rippling anisotropic effect. In 2000, a new version was released, titled *Fantasia 2000*, in which there is a story about life, death, and renewal, leveraging a female character created from water who morphs almost instantaneously into Mother Nature. These stories were driven by the music but created something visually astonishing. Both versions of *Fantasia* highlight the artists' understanding of dynamic forces in nature. Walt Disney's films has a way of capturing the imagination of children. Through the use of technology, the study of nature, and symbolism his films brought magic and wonder into my life when I was young. The first version of *Fantasia* sparked my curiosity of animation, while the second inspired me to start looking at nature for creative vision. The bulk of Walt Disney Animation films motivated decisions I made while making my animated short film.

The late 20th century saw the development of computer animation and digital compositing. These new elements allowed the film industry to achieve more complicated effects. Before this achievement, filming large bodies of water proved difficult to replicate often requiring location footage or huge tanks of water. "Water cannot be scaled down, so shooting miniature ships, rain or tidal waves is always a complicated and rarely entirely successful venture" (Rickett 177). Up to this point, water was considered an aesthetic. However in 1989's *The Abyss*, viewers would see the first character made digitally to look like water and create a magical scene with an actor. Effects regarding water and smoke were mainly used to help set the tone for the environment that framed the characters. This thesis explores creating a fluid character whose body and motion drive the characteristics of the fluid. This film created a lasting

impression on me because it looked truly believable. To my young eyes, it wasn't a cartoon character sharing the screen but an alien life-form that looked believable.

CHAPTER 3: PRE-PRODUCTION

Story inspiration

The original idea of the story was about a creature made of ink. He is born into a world devoid of any lifeforms. It originally opened to a scene of a puddle sitting in a stark white environment. The puddle begins to form into the character as he awakens. Inkling discovers himself and begins to look around only to realize he is all alone. He begins his journey to look for any other signs of life but cannot find anything. As he progresses further and further panic begins to set in until it finally reaches a boiling point. He explodes into a fit throwing his ink everywhere and falling to the ground in exhaustion. He wakes up to realize that his ink formed a cave. While looking around the cave, Inkling realizes that he subconsciously created the cave. After seeing this he understands that he can manipulate his environment and create a new world around him.

I originally intended the story to be about the struggles an artist faces when creating a new work of art. While creating the piece I looked at Absurdism and Existentialism. Camus and the philosophy of absurdism have one fundamental question: Is life worth living? *Inkling* does not answer that question but borrows more from the tale of Sisyphus. who cheated death twice. The first time he put Death in chains and escaped back to the living. Next, he persuaded Hades to allow him to return to the land of the living to tell his wife the proper burial rights. Camus writes, "he obtained from Pluto permission to return to earth to chastise his wife. However, when he had seen the face of this world again, enjoyed the water and sun, warm stones and the sea, he no longer wanted to go back…." (120) On his third attempt, Zeus greeted him, outraged that he had

bested the gods and thus doomed him to roll a boulder uphill for eternity. Early drafts of *Inkling* included a more extensive exploration into absurdist philosophy, and ended with a character having an epiphany that he could manipulate the world around him. Initially, the story was going to be my interpretation of Camus philosophy. "The struggle itself toward the heights is enough to fill a man's heart. One must imagine Sisyphus happy" (Camus 123). The ink released from his fit which became a cave, and when he stepped out, he created his own paradise symbolizing the artist's struggle until completing a work of art and finding his happiness within the piece. However, *Inkling* took a different direction.

By the third year of making the film I was diagnosed with stage 2 Non Hodgkin's Lymphoma. I was hospitalized in late September and my thesis project came to an abrupt halt. I returned to the program a different person; I no longer had the same mindset as before. I tried immersing myself back into the film, but I struggled to make progress because of the anxiety that stemmed from returning back to my everyday routine and seeing all the things I still needed to do. It became overwhelming and led to a cycle, much like Sisyphus, of feeling overwhelmed while working on *Inkling,* and the project metamorphosed into a short film about how people sometimes get stuck in a cycle of anxiety. It is an endless loop of everyday tasks until the anxiety builds and they ultimately explodes. In the new version of *Inkling*, the character is stuck searching for something in an environment where nothing exists except emptiness. His anxiety escalates to an unsustainable level as he searches. Finally, it reaches a boiling point, and he explodes. After releasing his energy, Inkling finds a resting place to fall again into slumber. The story is an inner reflection. Scenes were cut to reform the existing animation into the story that it

now is where *Inkling* is exploring how anxiety builds through a negative feedback loop, continuously escalating until he finds a way to release it.

Figure 1: Inkling discovering himself by Josh Cooper

Heavily influenced by Kafka and Camus, Inkling is born into a world of absurdity and begins to look at the possibility that happiness can be derived despite the loop of mental anguish.

Character inspiration

Careful thought and consideration were given to creating a design for the character. His movement and show of emotions were of the utmost importance. Computational time and hardware limitations were also taken into account. I referred back to my childhood inspiration Disney Animation but this time a more modern film than *Fantasia.* Inkling is highly influenced by the technical advancements of Disney's *Moana* and the procedural paper *Fluxed animated*

boundary method which focused on developing a pipeline for how the water was created. Inkling is based on that ocean character.

Moana's ocean character design was simple by nature, but they were able to create a visual persona that was aesthetically pleasing to the eye. Disney used a new method called Fluxed animated boundary to drive the simulations around the boats and the fluid characters in the movie. This method allowed the artists to sculpt a character and paint the velocity curves on the basic shape to help drive the simulation in a more believable way (Stomakhin 4). This influenced me to design a character that would help drive the ink simulation. As Inkling moves throughout the film, the audience will see rippling motion throughout his body.

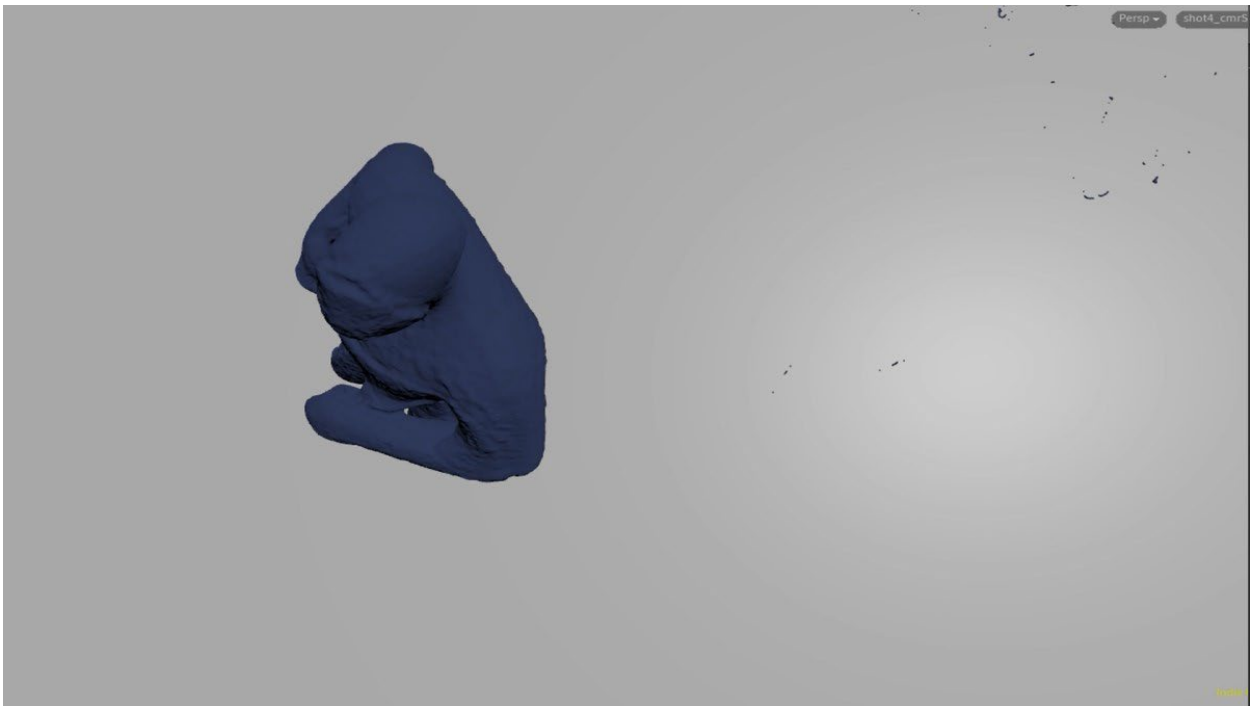

Figure 2: Rippling effect on the character by Josh Cooper

For my first time working with fluid dynamics, the choice of a simplistic figure was decided. The thought process behind the simplistic figure was that the mesh could be relatively low poly and remove unnecessary animation in the story's development. With this in mind, many

of the 2d drawings sketched early on showed some rippling fluidity. The character's face lacked certain facial features like a mouth and nose. Because there would be no verbal language and his emotions would be visible through his body language, a detailed face was not needed. This also allows the audience to relate more to the character because Inkling's non-descriptive nature enables the viewers to insert themselves and their own tribulations.

Studying the technical aspects of films like *The Abyss*, *Terminator 2*, and *Flubber* also led me to study the characters of those films as well. I wanted the same believability for my creature that the movie *The Abyss* created with theirs. I still wanted something the audience could look at and identify that as the head of the character and that he is looking in a certain direction. I also wanted Inkling to be able to morph like the effects in *Terminator 2*. The character needed to morph from a liquid state to a semi-liquid state like terminator 2. Lastly, Inkling had to be able to move around while still maintaining a readable character like the creature in *Flubber*.

The SideFX's software Houdini launch event showcased what Houdini's new features were. In the video, the audience can see water thrashing around in one spot. It is later revealed to be a character driving the simulation of the character. Next, they show a stream where fluid zombie-like characters emerge from the water and begin to walk down the river. This would later become the method I would use to drive my simulation of Inkling in the story.

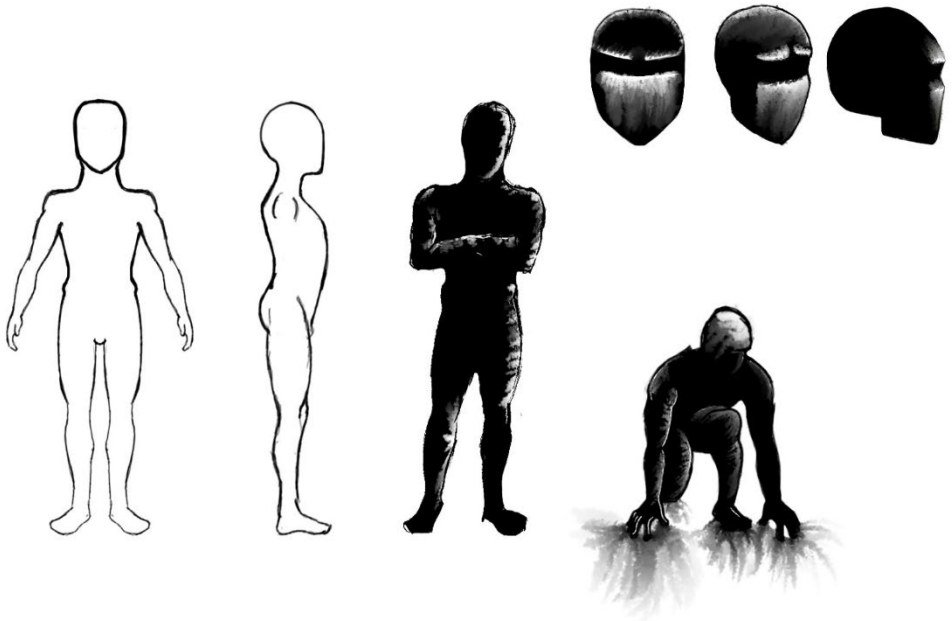

Figure 3: Inkling character Sheet by Josh Cooper

CHAPTER 4: PRODUCTION

With the character design finalized, the next step was to create a 3D model in Zbrush. The software contains a base bipedal character mesh which is utilized as a starting point for the model. The head was remodeled to remove facial features including the mouth and nose. The next step was sculpting the torso to soften the features leaving the original proportions. This was achieved by using a smooth brush within the software. The model was procedurally remeshed in Zbrush to re-attach the head to the torso. The model was then imported into Maya. While in Maya, the model was re-topologized to lower the poly count and to make rigging and skinning easier.

The first dynamic test was completed in Maya which was a 'proof of concept' to see if I could create a liquid creature. The vision I had for the character was a creature that formed from liquid rather than a character that contained liquid. In this test, the character mesh was turned into a container, and emitters were created to fill him up with fluid. The test included an N-particle emitter and a fluid 3D container that calculates the fluid effect. The gravity was reversed to allow the fluid to flow up and into the model. This process was a clumsy approach to the fluid simulation as it was computationally heavy and had limitations due to the strain it put on the processor and ram of the computer. Also, it looked nothing like what I envisioned.

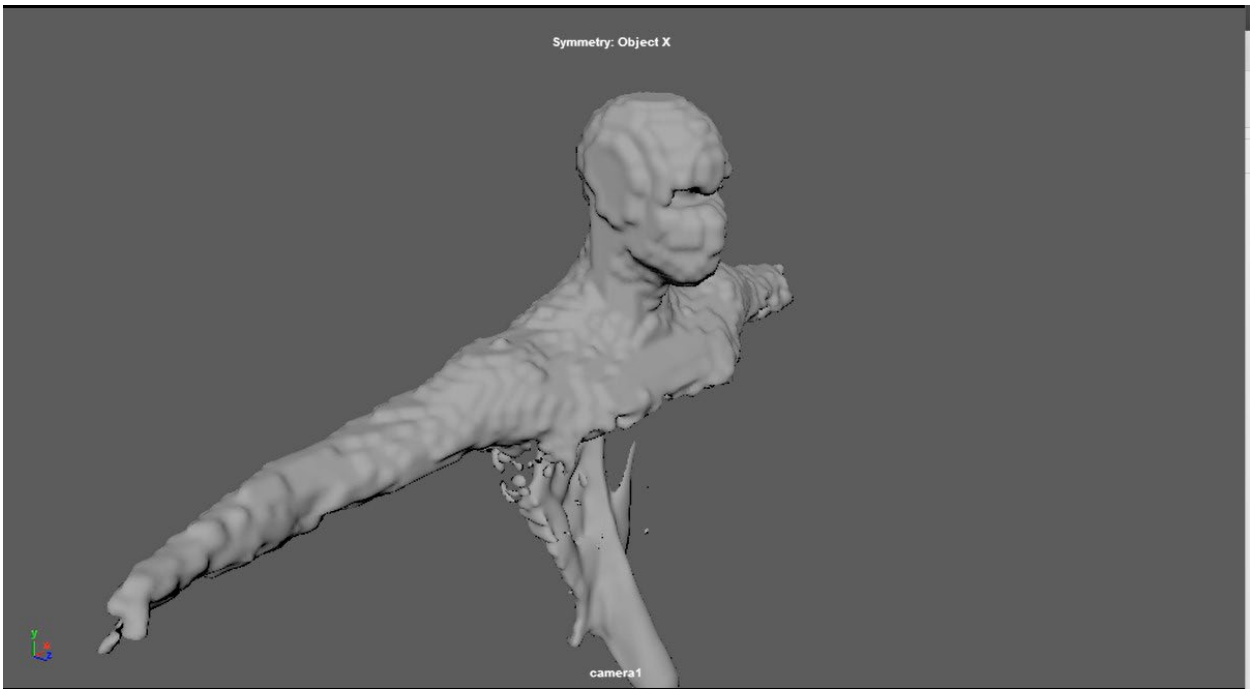

Figure 4: Maya fluid simulation test by Josh Cooper

While modeling and doing the first initial simulation of the character, it was necessary to work with an acting student named Michael Olaribigbe simultaneously. Sessions were booked at a motion capture stage at UCF's FIEA studio. Michael had to wear a special suit that allowed 53 reflective Velcro markers to be placed on his person. These markers allowed the cameras to capture the movements needed for the animation. Overall, this process required two sessions. When the desired results were achieved, the next step was to incorporate that data into the rigged character model. The data was imported into Autodesk's Motionbuilder. Certain aspects then needed to be removed, including the 37 cameras that initially captured the movement. The finalized rigged character model was imported and resized to match the file. The animation was then baked onto the character's skeleton. Animation layers were added to correct the animation and reduce the frames to roughly 24 frames per second (FPS) from the original 30 FPS.

The process moved to SideFX's Houdini. One of the most significant benefits of Houdini is allowing an artist to create in a non-destructive nature. Essentially everything created in this software is held in nodes. An artist would then build a chain of nodes to manipulate the scene they are creating. If the artist places a node in the graph editor but does not achieve the desired artistic effect, the node can be deleted or disabled to revert to the original state. The test in Houdini started with a sphere and a procedurally created puddle. The base fluid was created using two of the grid nodes and calculating the volume between them. To learn about the suction fluid tool in the toolbar I watched a tutorial Sidefx put out on their Houdini YouTube page. The tutorial instructs the user to select the desired object to influence the flip fluid and hit the Suction Fluid Tool (Suction Fluid). Suction force was applied to the sphere which created numerous nodes in the flip solver. The antigravity node reverses the gravity on the individual particles within a set radius around the sphere. There is some overlap with the suctionforce node and the antigravity node. The overlap is the range of influence it has outside the object that is sucking the fluid up.

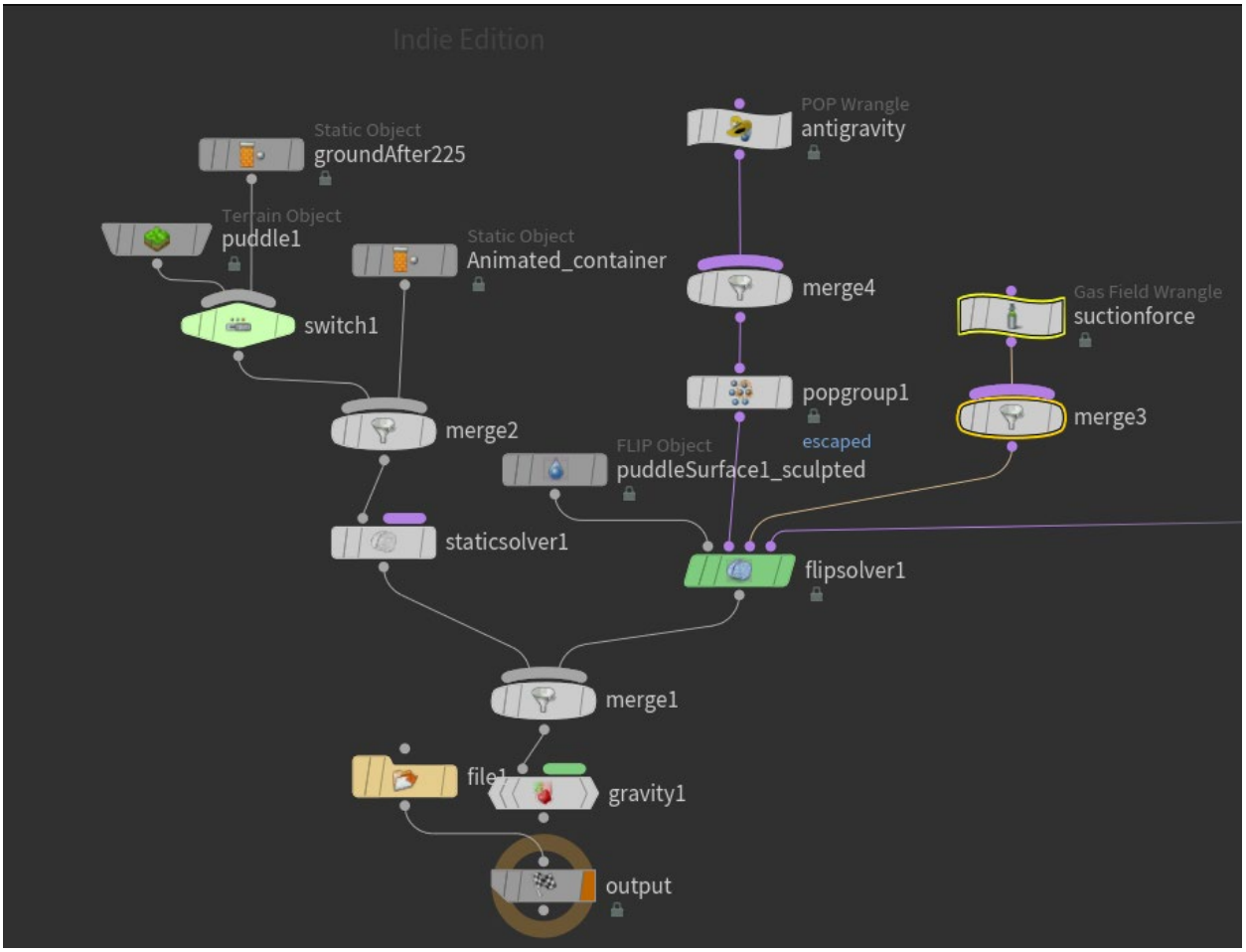

Figure 5: DopNetwork of the final simulation by Josh Cooper

The result pulls the particles into the sphere. Once the sphere fills, the suction force is applied only to the contained particles, and the puddle becomes stagnant. At this point, the sphere then moves forward. That sudden motion of the sphere causes the particles' velocity to rise to a threshold greater than the force holding the particles together causing them to continue moving forward after the sphere stops.

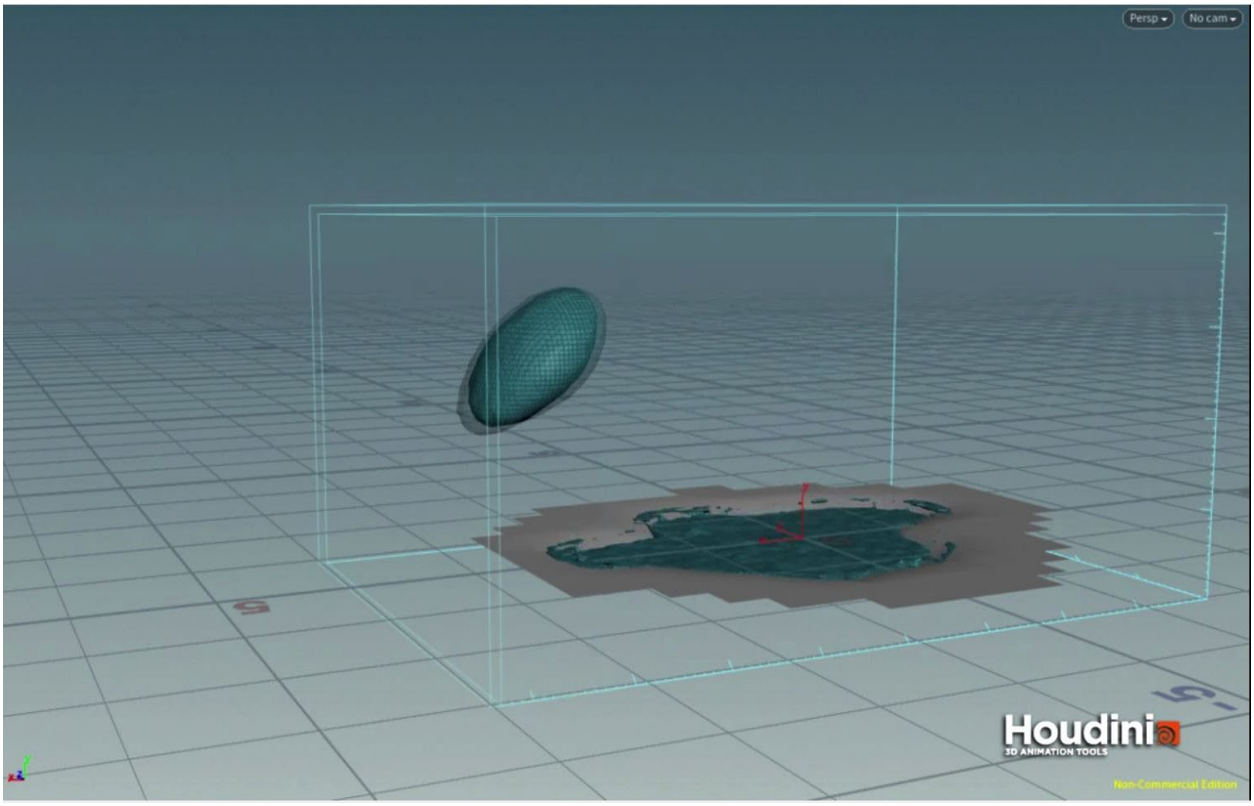

Figure 6: Fluid test in Houdini by Josh Cooper

The test was successful because I could get the sphere to absorb the particles from the puddle and have it initially retain its shape before the motion. There were a few tests after that which changed the consistency of the fluid making it more viscous. However, at the time, it was the only way to get the sphere to hold on to the particles after it started moving forward.

Applying the tests to the finished animation

After importing it into Houdini, the previous test process was applied to the character. The character began filling up, but the animation took too long to fill. A solution was needed to fill it faster. The first attempt to find a solution included spheres hidden within the mesh and turning them into flip emitters. This process still was not efficient enough. The next attempt cut the mesh of the character into sections and turned those sections into emitters as well. The

process for this solution was straightforward. The suction force started from the bottom up, and as it reached the knees and shoulders of the character, those emitters would turn on and immediately be affected by the suction force causing the simulation to speed up. Once the character was filled, he began to move around. No matter what was changed regarding the suction force or the fluid's viscosity, the particles' velocity was too high, and particles shot everywhere.

The thesis committee was consulted for alternative ideas to get the character to maintain his shape and hold the fluids within him but not have it look like the fluid is sloshing around in a container. A solution was achieved that created a second mesh of the character, slightly larger than the original mesh containing the fluids. This method initially did not work either, and the absorbed particles shot to the outside of this container, causing the character to look slightly inflated.

Looking through the settings in the node and closely examining the code, I still could not figure it out and was unsure what needed to be turned on. One Thesis Committee member, Cheryl Briggs, recommended speaking to Jason Mayer, a digital effects artist at DreamWorks. He kindly created and sent diagrams that helped break down several methods for solving this complex issue.

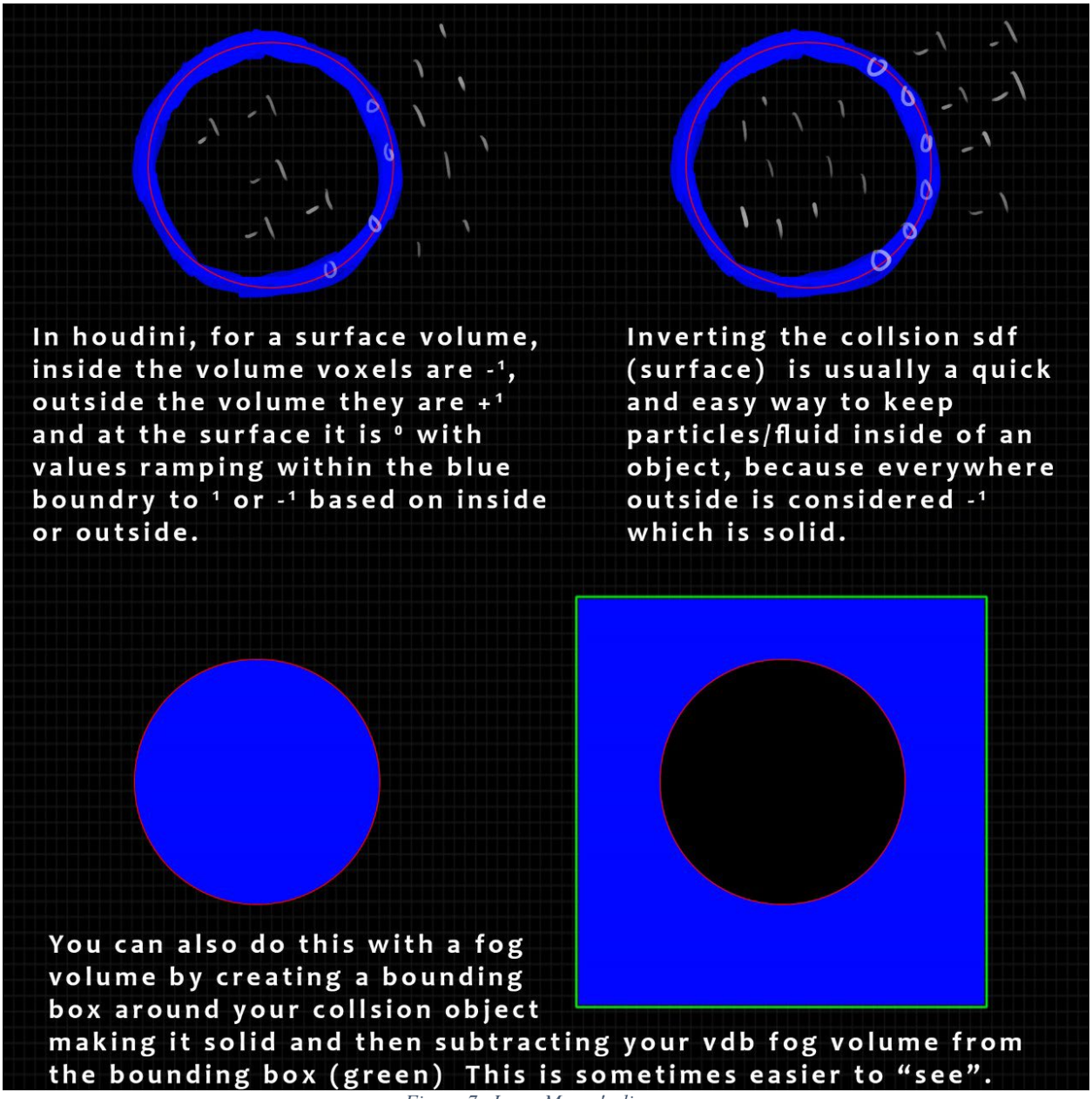

Figure 7: Jason Mayor's diagram
Source: Email correspondence with Jason

Because Jason did not have the file to see each node, he gave some suggestions that could help. The first suggestion was to add more substeps into the dopnetwork but that would add more time to calculating the simulation. The next suggestion was to add a bounding box and turn that into a fog volume and use the negative shape of the character to contain the fluids. In this suggestion,

he said to invert the collision sdf (Mayer). That email led to the realization that the original container had an unchecked invert option box. I checked that box, re-cached my simulation, and the simulation began to work.

The character was maintaining his shape while in motion, so I applied a life cycle to the particles to kill them off to avoid the simulation becoming resource heavy. Using an attribute wrangle, I initially tried to create a VEX script which would create a bounding box around the character and keep those particles from dying while allowing the other particles to die after a random time for each particle. This process did not work, and the character eventually ran out of particles. Once again Jason was contacted with what was happening; the scene file was sent to him. He took the time to explain a new approach which would be more efficient and actually work. This method creates a VDB volume which I could then use to group all the particles outside this volume and apply a life cycle. With this method, I created a visually appealing cycle where the fluid gradually evaporates. This allowed for a higher fidelity within the simulation. I could cache the different shots' simulations and apply lighting and textures.

Texturing and Lighting

Pixar's Renderman is an excellent tool for lighting and texturing the scene. Pixar created the software to create a multitude of different lighting and textures in the film industry. The software is robust and allows for complex shaders to be made. Pixar also allows students to use their software for free for educational purposes. With this in mind, the texture for the fluid mesh had to be something the rendering software could use. The shader for the ink fluid consisted of the pxrsurface shader. The default color was adjusted to black. Under the glass tab, refraction

gain and reflection gain were adjusted to create the reflective aspect of the ink surface. Under the subsurface tab, gain was adjusted to 1, and the color was adjusted to a grey tone. This completed the simple shader for the black ink

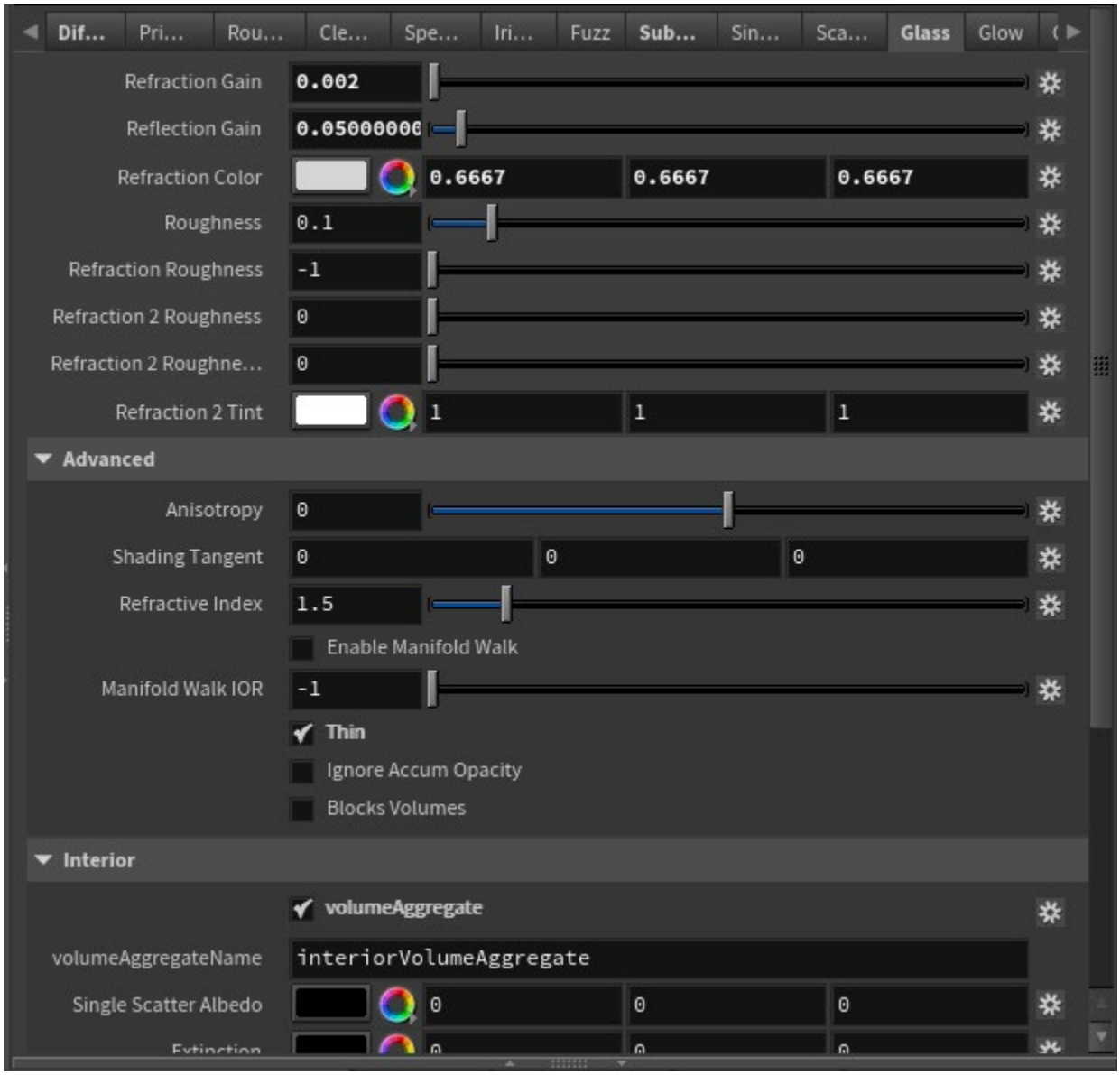

Figure 8: pxrSurface glass properties by Josh Cooper

Lighting has two different setups: there is a three-point light used for the character which creates shadows and specular highlights on the character. And then, there is an environmental

HDRI light which fills the environment. The lighting follows that of a Disney animation where the beginning scenes are warmer color tones. As the story progresses and begins to hit the climax, it moves to a darker, cooler color palette, and after the resolution, the scene reverts to brighter, warmer tones. I wanted the colors to reflect Inkling's emotional state. As the film progresses and his anxiety builds, the color begins to shift to a dark cooler state while simultaneously using a vignette to narrow the view of the environment. This manipulates the audience into a feeling of distress until the climax hits.

CHAPTER 5: POSTPRODUCTION

For compositing, the software of choice is Nuke. This software allows much control over the color, timing, and individual components of the plates. After importing the character and environment plates, I shuffled out the different passes to manipulate them to my artistic vision and then merged them to one another. Each shot had a slightly different workflow. The unconcluded, indirect specular, and direct specular pass were separated by a shuffle node from the main character plate. The unoccluded pass would be merged typically with a multiply operation with the background allowing the light tones to affect the environment pass subtly. but depending on the shot and if the lights changed, the operation of the merge node could be different. Shot 005 is a prime example of changing the structure of the typical layout for other shots. The lights do change over time, and extra nodes were added to get the desired look of the film. The unoccluded pass had two different merge nodes that fed into a switch node. At the desired frame, the switch would allow the redirecting merge process.

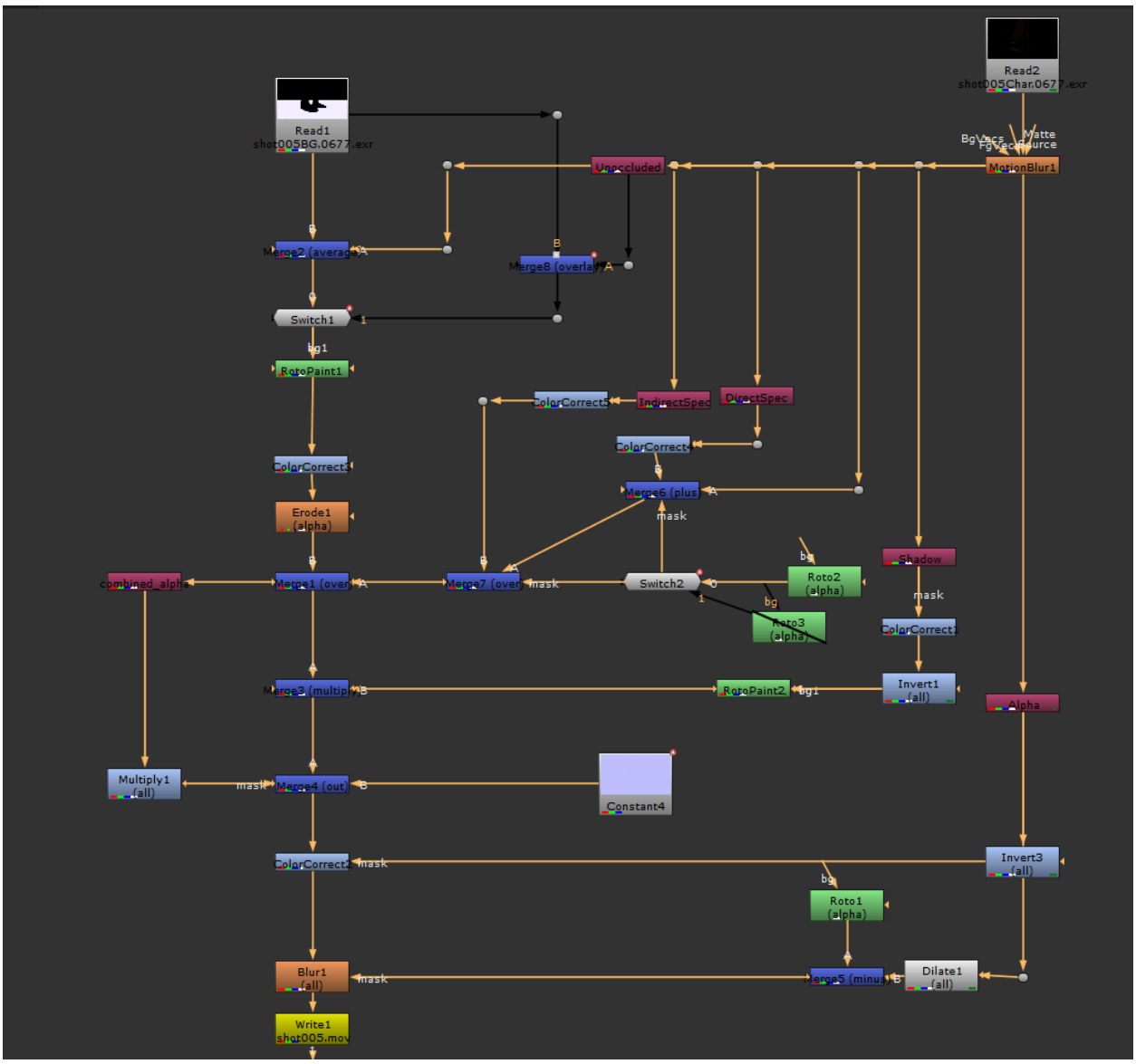

Figure 9: Shot 005 Nuke node tree by Josh Cooper

Each scene needed individual adjustments in how the plates were combined. Garbage mattes could be used if there needed to be something excluded from the scene. In shot 005, the simulation didn't perform as expected, so a rotopaint was added just after the merge with the unoccluded pass, and the simulation imperfections were painted out of the shot. Color

corrections were on a per-pass level as well, and this allowed for the final scene to be more desaturated while still having the character's specularity pop in the scene.

CHAPTER 6: CONCLUSION

This film was a successful experiment in creating a complex character that is made by a fluid simulation. The character's animation helps drive the simulation, creating exciting fluid motions. With more time, further investigation into Walt Disney Animation Studios' paper on FABS could introduce their concepts into the animation to help drive the simulation in a more artistic way. The next phase of this project will be to focus less on reacting to how the animation is driving the simulation and begin to artistically mold the simulation to create visually appealing characters.

This initial animation will be posted on youtube and be used as a beginning demo reel piece to start applying for jobs in the industry. With further studies in visual effects, the short film will be revisited to apply new methods to see what type of effect can be achieved. With software and hardware advancements, special effects will not only be used to create reality based worlds and simulation. In the future, these tools will be able to capture a new aspect of human imagination that will lead animation into a more modernist approach that fully embraces abstractism.

APPENDIX JASON'S APPROVAL

Re: Thesis paper

Jason Mayer <jasonwmayer@yahoo.com>
Wed 9/7/2022 4:30 PM

To: Josh Cooper <coopj@knights.ucf.edu>

Hey Josh,
Of course, feel free to use them
I wish i'd made them nicer ;)
Does this mean you're finishing up soon?

cheers,

Jason

On Wednesday, September 7, 2022 at 12:08:49 PM PDT, Josh Cooper <coopj@knights.ucf.edu> wrote:

Hey Jason,

Do you mind if I use the diagram/quote you in my paper? You shared it with me to help explain collisions and how to fix my guy? if you need me to send it back to you to refresh your memory, let me know. Thanks for your time and help.

-Josh C.

LIST OF REFERENCES

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