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Naga: Combining 2D and 3D Animation.

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NAGA: COMBINING 2D AND 3D ANIMATION

Thesis submitted in partial fulfillment of Honors

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Introduction: the project

Naga is a animated short about a lively dragon that roams about the lands embracing it's surroundings dearly. It discovered a barren land while out exploring and was saddened by the sight. After pondering for a while, it then realizes it could revive the land with it's ability to summon rain using its dragon ball. The short blends traditional animation and computer animation, where the look is similar to 2D animation but the character and a few environment elements are done in 3D. Software utilized to complete the short were Autodesk Maya, Adobe Photoshop, Clip Studio Paint, Adobe After Effects, and Adobe Premiere Pro. The short showcases a stylized Chinese traditional ink painting style, keyframe animation, and particle effects. The whole production spanned roughly 18 months with frequent breaks in between due to concurrent coursework during the semesters. The short carries a hidden message: the environment is a beautiful but fragile gift that we must protect and conserve for our future generations, because sadly there exists no dragons that can magically fix our mistakes.

Concept art for *Naga*.

Background: how the project came about

The main character of *Naga* is a dragon because I have always been fascinated by dragons since a young age. Dragons are also part of my Chinese heritage and are held in high esteem in my culture. Unlike western dragons who are often depicted as fire-breathing beasts to be conquered, in the east, dragons are celebrated as powerful, mysterious and noble creatures, and believed to bring abundance, prosperity, good fortune and divine protection (Origins). While going through some information on the internet, I came across an interesting theory about the number of toes on a dragon determined it's origin. According to that theory, dragons from China have five toes and as we get further from China geographically, the number of toes the dragon has decrease. As such, dragons from Korea will have four toes while dragons from Japan will have three toes. The dragon featured in *Naga* has four toes because symmetrical models are easier to make, and also because I referenced dragon illustrations by Chunjiang Fu from Origins of Chinese People and Customs.

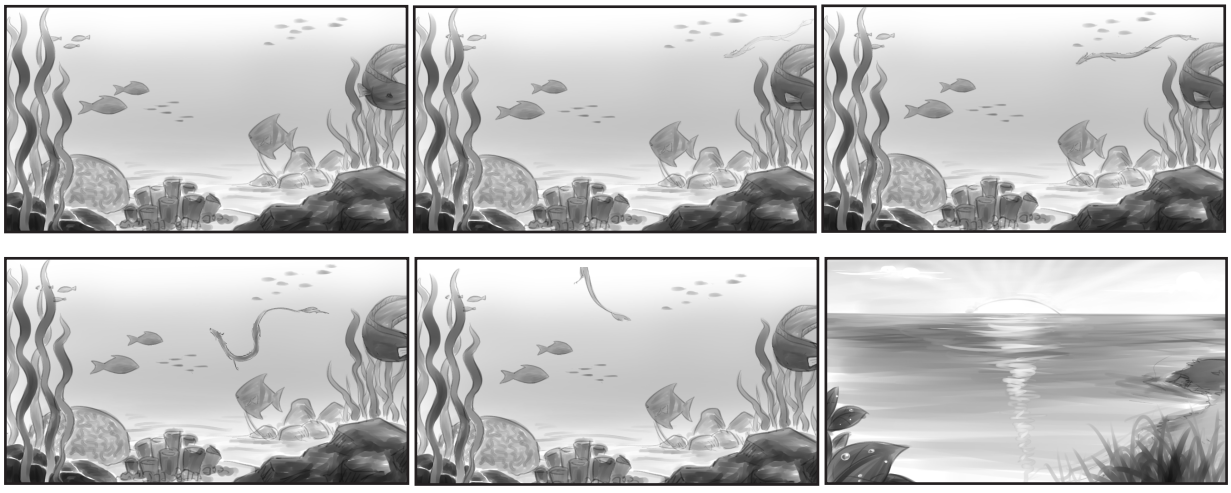
The plot for *Naga* was inspired by a segment in Disney's *Fantasia 2000*, where they animated pictures to the 1919 version of Igor Stravinsky's *Firebird Suit*e. It was about a spring fairy and her companion elk who accidentally awakens the Firebird, a fiery spirit of destruction near a volcano, resulting in the devastation of the surrounding forest. Fortunately the spring fairy survives the ordeal and the elk encourages her to restore life to the forest. Another inspiration and reference for the short was a 1999 Hong Kong Drama titled *Dragon Love*, which was a story about a forbidden romance between a human and a dragon. The movements of the dragons while summoning rain in *Dragon Love* influenced how my dragon danced around it's orb to summon rain. I also took inspiration from Chinese myths and legends about dragons forming the four great rivers in China.

Brainstorming: the idea

Some build worlds before creating characters that live in them while others develop a plot before settling on the environments and characters. I created my character, the dragon, then proceeded to develop a story revolving it. In *Naga*, the dragon's ability to summon rain using a dragon ball helped to advance the plot.

Storyboard / Animatic: the plot

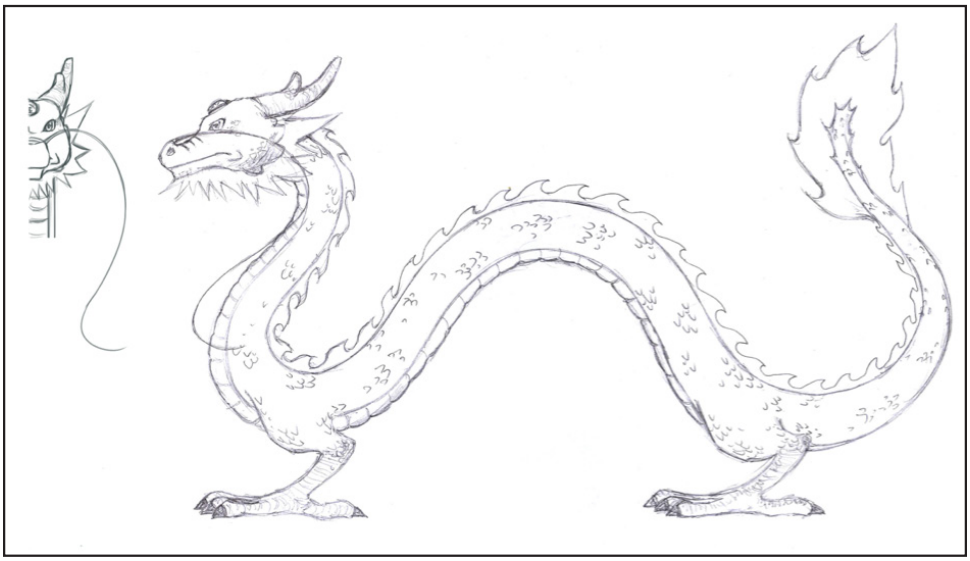
A storyboard is sequence of rough images that tell a narrative. Sometimes, the images have brief descriptions and notes to help clarify the scene, camera movements, or record dialogue. First, I sketched the frames on paper and showed them to my thesis advisor for suggestions for improvement or changes. Then I re-sketched the storyboard with a tablet and pen in Clip Studio Paint and imported the individual images into Adobe Premiere Pro, arranging the frames in sequence to create an animatic. I also matched the sequence with suitable sound effects and soundtracks found on the internet to help set the mood of the piece. Creating an animatic is important to help set the pace and timing for each of the scenes. A story can have several versions of animatics based on the feedback by a director.



Several frames from the storyboard.

Visual Development: the look

Visual development was an ongoing process which spanned throughout storyboarding, creating the animatic and building all the assets required for the animation. After deciding on my main character, I made profile and front sketches of the character so I know how the character will look. The sketches served as a guide while I modeled the character using Maya.



Character sketch.

Then, I painted concept art for the short using Clip Studio Paint, a Japanese painting program, instead of Photoshop because Clip Studio Paint had more suitable brushes for my project. Photoshop is excellent for painting but I would have taken a longer time to achieve the overall desired look. I wanted the short to look similar to traditional Chinese ink paintings thus I searched the internet for examples of Chinese ink paintings so I can emulate the style. Referencing my traditional Chinese ink painting notes also guided my stroke and color choices. The end product was a mixture of painterly style, watercolor, and ink outlines.

The short features a stylized Chinese traditional ink painterly style, watercolor, and ink outlines.

Next, I had to decide how to achieve the look within a reasonable amount of time. After discussing with my thesis advisor, we agreed to have image planes arranged in 3D space as it shortens render time. Initially, I wanted to ink and paint the dragon frame by frame by hand after the animation on the character was done. However, the endeavor proved extremely time consuming after making several test clips. After experimenting with toon lines at the suggestion of my thesis advisor, I decided to use it on the character in far shots while inking the character by hand in closer shots to be more time efficient. I opted to use toon lines in select shots where the outline is not going to be a big focus in the frame because the lines produced at the whiskers of the character were thicker than the rest of the lines, making the overall look unbalanced.

Building Assets: creating all the elements

Out of all the assets, I built the dragon first despite not having settled on a story for it. While working on the model, I saved in increments as backup in case of file corruption.

Before I could animate the dragon, I needed it to be rigged; however since I lack the skills, my friend and classmate was gracious to offer to rig the character for me. In the meantime, I worked on painting the dragon model in Mudbox. Instead of the regular painting process, I opted to use pTex because pTex does not require me to UV map the object I wish to paint. UV mapping is akin to laying out the surface of a model with no overlapping.

After that, I painted all the assets needed for my scenes using Clip Studio Paint and Adobe Photoshop. To help my paintings look accurate, I searched the internet for references such as different mountains, a variety of trees, coral, plants, and desolate terrains. I mainly painted with Clip Studio Paint because the program had excellent brushes and tools I could use right away without spending too much time customizing them to my liking. For some of the processes and effects that Clip Studio Paint could not achieve, I used Photoshop. For example, it is easier to sketch out frame by frame animation using Photoshop's Timeline feature than to use Clip Studio Paint where I am unable to preview my animation. Another reason is the greater variety of automated filters at my disposal with Photoshop, such as the difference cloud filter and noise filter.

When I had enough assets, I started building the scenes according to the storyboards. I mapped the assets onto planes and arranged them in 3D space to create the illusion of depth. Sometimes, I had to paint more assets or repaint some assets when they failed to work with the current scene I was building. I also utilized the Visor in Maya to make the bulk of the fluids such as underwater caustics, clouds, and fog, and some special effects such as Paint Effects. It had preset scenes and brushes I could tweak to suit my needs. The main Paint Effects used were seaweed, kelp, grass, and bare trees. As mental ray does not render Paint Effects, they had to be converted to polygons after the look was finalized. Otherwise, Maya Software was used as the renderer.

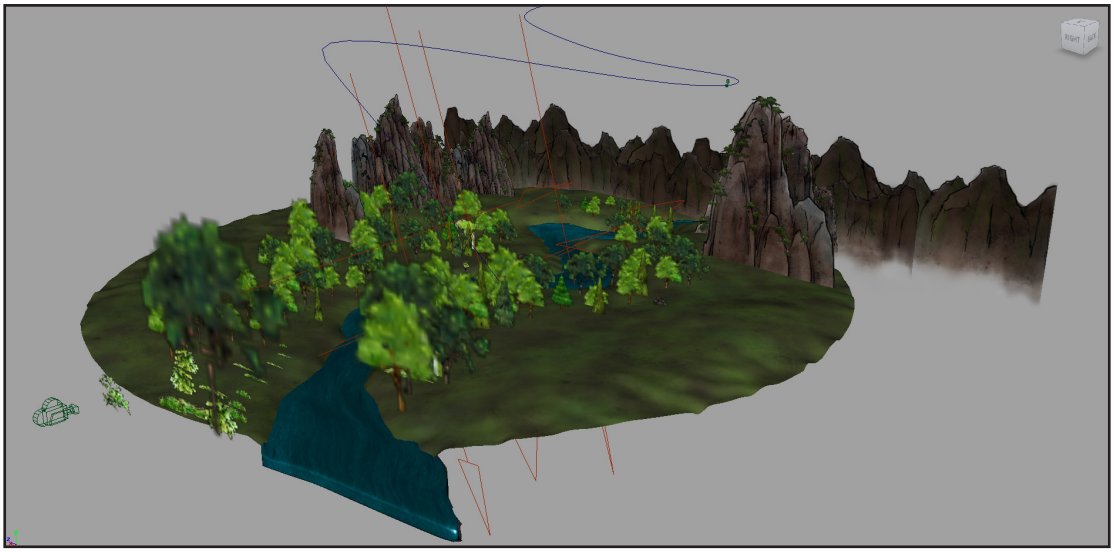


Image planes arranged in 3D space.

Animation: objects, character and cameras

With the help of the animation feature in Photoshop, I blocked out sketches of a growing shoot frame by frame to make sure the animation was smooth before I inked and painted. Where the motion was not smooth, I added more frames. To get the motion right, I searched the internet for reference images on the growth of plant shoots. At the same time, I also searched for more efficient ways to have the plant shoot animated, such as using blend shapes in Maya. The motion using only blend shapes looked unnatural. After much experimentation, a combination of blend shapes and simple bones produced the best result. Once I was satisfied with the animation, I saved a geometry cache for the plant shoot, and exported the plant shoot mesh as an FBX file to import it into other scenes. By offsetting the geometry cache, I was able to obtain varied timing and movement for multiple plant shoots from one cache.

I animated a growing tree by keying stroke time and time clip under the flow animation section of the "treeBare" paint effects brush. I then arranged and animated planes of clusters of leaves I painted along the branches, to preserve the painterly style of the short. Once I was satisfied with the motion, I converted the paint effects to polygons so it would render with mental ray. Next, I cached the animating tree with alembic cache. By doing so, I could import multiple copies of the cache into a scene with the tree animation already present. To adjust the timing of the cached animation, I broke the connection to the time node and keyed it.

To simulate water flow, I animated the texture and bump map of the river mesh so they moved in relation to time. For clouds made using a fluid container, the expression:

cloudLayerShape.textureTime = time*0.1,

automated the movement of the Perlin Noise texture to mimic rolling clouds. To create lightning flashing in the storm clouds, I keyed the intensity of several volume lights placed strategically among the clouds. Animation on cameras were kept to a minimum to suit the relaxed pace of the short. I referred to 'Growing' Geometry Along a Curve by Christina Johnson, a tutorial on

attaching geometry to a motion path and letting it move through a deformer, to “grow” the river that appeared at the end of the short.

Initially, I approached animating the dragon by starting with a flying cycle, as a large portion of the short involved the dragon flying. With animation layers, I could give variation to the otherwise uniform cycle. However I had difficulties deciding on the flying mechanics of the dragon, so I ended up building curves that represented the paths the dragon would fly and then using the curves as reference to position the dragon. Later, I cleaned up the poses and added anticipation when needed. When I was satisfied with the movement, I offset the key frames to obtain overlapping motion. In one shot where the dragon is facing the camera and flying through clouds, the controls were driven by two sine deformers on a curve with expressions connected to the offset node of the deformers. The dragon’s whiskers were driven by a hair system, where I could turn the dynamics on them on and off in the master control of the rig. Depending on the scene, I animated the “goal” curve for the hair system for better control over the hair simulation.

Effects Animation: particles

The bulk of effects animation such as rain and dust, were done with nParticles as they have finer controls than regular particles. The movement of the particles were controlled using fields, mainly with volume axis as only particles in the volume are affected, allowing better control over them. Once I was satisfied with how the particles moved, I cached them so the system would not have to run the simulation for the particles every time I played the segment. Caching the particles also allowed me to scrub in the timeline.

A few scenes had rain made in After Effects, with the CC Rainfall effect. Also, bubbles in the underwater scene were generated in After Effects.

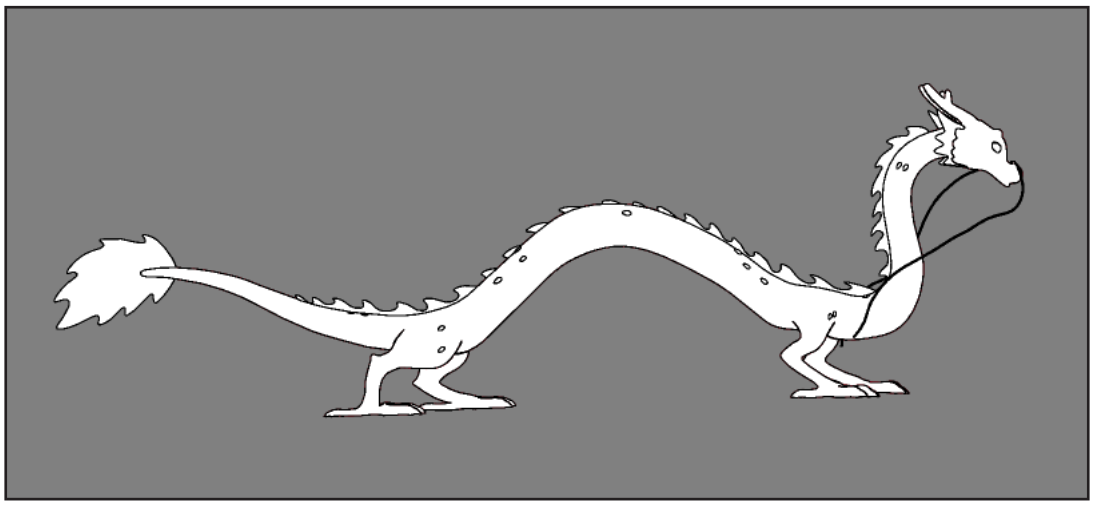
Rendering

To make sure the scenes look right, whether it is subtle animation or object placements, I ran many test renders as I built the environments. For more control when compositing, I rendered several different layers of the same scene by setting up render layers so I could do finer adjustments such as color corrections and changing blending modes for better results. With the help of the render farm, I could render multiple scenes at the same time without bogging down a single computer. The majority of scenes were rendered with mental ray, paint effects were rendered with maya software, while some particle effects such as multistreak and multipoint nParticles were rendered using maya hardware.

For a glossy finish on the dragon's body, I used the maya material x passes shader with the presets set to pearlFinish, blended with 10% of GlazedCeramic and 35% of GlossyFinish. However, the glossy material seemed out of place when the dragon was placed together with the other assets. Therefore, I replaced the preset with matteFinish. An interesting observation I had while test rendering the dragon was, whenever the dragon was behind planes mapped with an alpha channel for transparency, pTex on the dragon would render black. Rendering out in layers avoided the black rendering problem with the dragon.

PTex rendered black behind transparency.

Line art or contours for the dragon ended up as a combination of toon lines and contour rendering. To obtain contours, I made sure to turn it on in the render settings and shader. The default for toon lines were Paint Effects and thus only renderable with Maya Software. Changing the toon line type from Paint Effects to Offset Mesh allowed me to render with mental ray. Smoothing the toon line mesh helped me obtain nice smooth lines.



A combination of toon lines and contours.

Compositing: putting everything together

As I completed the animations, I overlaid playblasts of the scenes atop of the animatic. With that, I realized some scenes needed more screen time and so I went back in and made adjustments. As a result, the audio had to be tweaked as well to fit the new cuts.

The rendered images from Maya were composited in After Effects. I created multiple compositions in one centralized (After Effects) composition file for easier access. I also maintained different folders within the composition file to keep things organized. To make compositions cohesive, I applied color correction and levels adjustments to the images as necessary. For some image sequences, I applied the Cartoon effect to decrease the realism in them and make them more stylized in accordance to the style of the short. I also layered a watercolor texture over the compositions for a more traditional look.

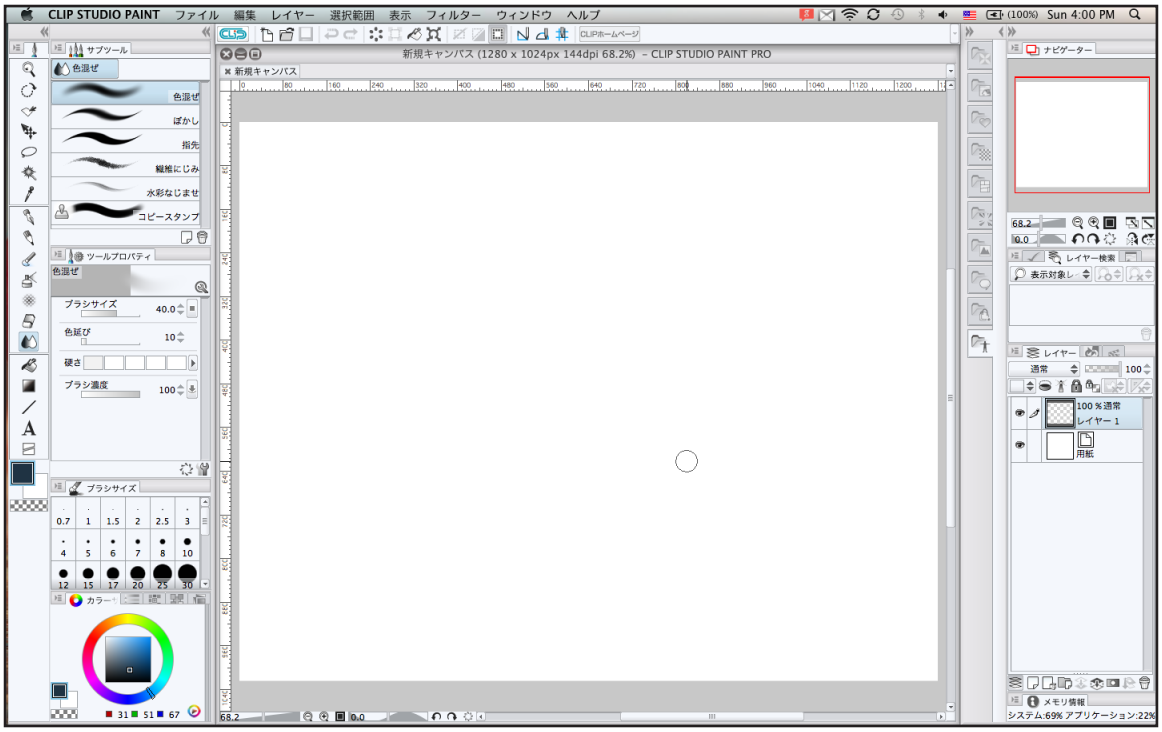
Finally, I imported the main composition file into Premiere for final editing.

Layers allow for finer adjustments during compositing.

Challenges: the problems

There were several challenges I faced while completing Naga.

Obtaining the art program, Clip Studio Paint, was a challenge in itself due to the language barrier. The official version of Clip Studio Paint was only available in Japanese and only sold on their official website. I discovered the program during it's Beta testing stages. Despite the language barrier, I decided to try the program after watching the promotional video for it. I quickly found myself in total adoration of the program and had to acquire the program when it officially rolled out. Registering for an account on their website was fairly easy. However when it came to purchasing the program, I was not able to add "gold," the currency used on the website because I was using my debit card instead of a credit card. I finally successfully purchased the program after obtaining permission to use my parents' credit card.



Clip Studio Paint.

Another challenge was painting with pTex using Mudbox. It took several attempts for me to be able to paint successfully in Mudbox. The paint would affect other parts of my dragon when I did not intend for it to do so. One of my classmates pointed out, I needed to prepare the parts I intended to paint individually by only having one part of the model visible while preparing the object for pTex painting. After the painting hurdle in Mudbox came the rendering hurdle in Maya. All my renders in the computer lab turned out black even though the Maya registry file, maya.rayrc, was updated with a new line:

registry "{_MI_REG_CCMESH_PTEX}" value "on" end registry

for the pTex node to appear in the Hypershader in Maya. It turned out the updated Maya registry file needed to be in the "prefs" folder in the "My Documents" "maya" folder, as follows:

\\etsulab1\users\CHINM1\My Documents\maya\2013-x64\prefs

A new pTex painting challenge presented itself when I attempted to repaint my dragon as the number of edge loops changed for the mesh to ease rigging. The paint would disappear or become randomized after I reopened the saved file. I tried changing the preferences for the files to save pTex together with files, which resulted in larger file sizes and slower saves but the paint layer still became randomized. PTex finally loaded properly on the mesh in Maya after I exported the paint layer before closing Mudbox.

Randomized paint in Mudbox when reopening the saved file.

The next challenge was rendering the desolate land scenes. To add detail to the ground I tried displacement maps with unsatisfying results where the renders looked extremely pixelated. I tried bump mapping instead and obtained a good result. Another rendering problem was having supposedly transparent areas render visibly darker. Using PNG image format was the cause even though PNG files support transparency, mental ray seemed to have problems rendering them properly. Once the files were replaced with Targas (TGA), an old but proven file format frequently used in film and TV, the images rendered with proper transparency. Changing the shader type from Lambert to Surface Shader corrected the problem as well. However, Surface Shaders failed to render alpha channels correctly without mapping separate monochrome images to the matte opacity node.

After finishing the animation for the flying scene driven by 2 sine deformers, I discovered maya would crash whenever I tried to scrub past frame 12. I was baffled as there were not any visible problems with the file. Since time was short, I ended up asking my friend to help me render that scene as a temporary fix.

Working with alembic cache presented some challenges as it was a new feature to Maya 2013. According to the Alembic website (http://www.alembic.io/index.html), a use for this cache was to bake animations of scenes and later to be handed off to lighting and rendering. When I imported the alembic cache of a growing tree into the scene, the animation imported but the textures on the tree did not import. No UVs were present for the alembic cache when I double checked with the UV Texture Editor. I tested out 3D textures without success. Documentation on alembic cache on the Maya help site led me to advanced options before exporting the cache. Checking the UV write option before exporting ensured the cache had UVs and in doing so, the textures for the tree bark animated correctly without strange pixelations. Still, I had to re-assign shaders to the cache because it does not embed textures.

I also had some trouble creating particle effects for “growing” the river to simulate water splashing. I attached a surface emitter to the motion path the river “grew” on but the particle collision looked messy and unpredictable. The particles trailed behind as a result of great forward motion by the emitter. After switching the surface emitter for a volume emitter and increasing the forward directional speed as well as adding random speed, the particles finally behaved closer to water gushing.

One of the major challenges was getting the dragon rigged and working. I had trouble opening some of the rig files my friend sent over. They kept crashing every time I attempted to move within the 3D scene for unknown reasons. The problem was fixed temporarily by re-saving the files as Maya ASCII format. When my friend notified me he was not able to finish the rig on time, I had to ask my thesis advisor for help. He managed to finish a rig quickly by building upon the rig my friend sent. With it, I made test animations to explore the range of motion of the rig. To improve the rig, I gave feedback to my thesis advisor and described the type of controls and features the rig should have, such as snake-like movement for the dragon. Getting the mesh to deform correctly was a challenge. Some of the strange deformations were taken out by repainting the skin weights using the Paint Skin Weights Tool with the help of the Component Editor. I also adopted blend shapes to tweak some of the deformations.

While animating, some point on poly constrains on the scales of the dragon shifted unpredictably as the body moved. If the move was not noticeable, I left them alone; otherwise, I deleted some of the scales.

Final Thoughts

The majority of the project was figuring out how to make things work to achieve the look I was going for. It definitely involved a lot of creative thinking, problem solving, and collaborative effort, not to mention long hours and late nights. Nonetheless, the sense of accomplishment after completing a large project such as *Naga* was tremendous.

Reference

Johnson, Christina. 'Growing' Geometry Along a Curve. 2003. Web 3 Jan. 2013. <http://vcell.ndsu.nodak.edu/~christjo/vcell/Tutorial/tutorial1.htm>

Origins of Chinese People and Customs. Trans. Geraldine Goh. 7th ed. Singapore: Asiapac Books Pte Ltd, 2006. Print.

Appendix

Music and sound effects I used in *Naga* are listed in the table below. Most, if not all were in the mp3 format.

	Composer	Title	Source
BGM	Musmus	春宵闇二咲ク	http://musmus.main.jp/
Sound EFX	-	nature012	http://www.grsites.com/archive/sounds/category/16/?offset=0
	Mike Koenig	Rain Background Sound	http://soundbible.com/2011-Rain-Background.html
		Perfect Thunder Storm Sound	http://soundbible.com/916-Perfect-Thunder-Storm.html