

This is the shot list for my production animation reel. It has reference images corresponding to the scenes on the reel, and short descriptions highlighting the work I did on each of these scenes.

The scenes on this reel are selected from four significant production efforts I was involved with during my time as a CGI Technical Director (TD) at Walt Disney Feature Animation. These are the feature films *Mulan* and *Lilo and Stitch*, the *Pooh's Hunny Hunt* attraction at Tokyo Disneyland, and two internal *Roger Rabbit* tests. The one additional piece is from a swarming particle system I wrote from scratch, and have tinkered with a bit.

At Disney, I wore multiple hats. The two official ones were what Disney refers to as Production Software TD and Look Development TD. I was involved with the design and development of various pieces of software, ranging from small scripts to larger scale production and production management tools. Some were very specific, and some were used on multiple shows. I was also involved with the design and development of the rendered look for a number of computer-generated (CG) elements. This includes shaders, textures, the leveling of the elements and the boiler plate compositing setups, as well as general shot work. The shot work typically involved rendering the various levels for the CG elements, adjusting and tweaking, touch up paint work, compositing, and showing the images to the Directors for Cleanup Approval. It also involved the inevitable special cases and one-offs, such as situations where additional paint work or scene-specific matte work was required.

During a time when the trend was toward specialization, I strongly favored the role of generalist. This gave me a broader perspective by allowing me to touch more parts of the process, and provided opportunities for working across departmental boundaries and doing things that a pure specialist would not do. This includes things like working with Layout and/or Scene Planning on shot mechanics, to working with Backgrounds to define the look of an element that was sometimes a traditional BG and sometimes CG, to working with Color Models and the Art Director on colors for CG elements, to working with Effects on the integration of 2D and 3D, to working with Imagineering on designing CG elements for video projection onto a half-silvered mirror for a theme park attraction. I even painted a background element, and did some minor animation. All these served to enhance not only my skill, but my reputation as a problem solver. This broader perspective also heightened my awareness of, and my focus on, integration issues rather than the “hey, look, this is a CG element!” mindset that too many folks have.

## Scenes on the Reel



Source: *Lilo and Stitch*

CG elements: red cruiser, Stitch, blue cruisers, star field, debris

Description: The red and blue cruiser elements were similar, structurally, having ink line and paint levels as well as several mattes for tones, the cockpit window, the specular highlights, and the jet blast and glow. The blue cruiser element also included a z-depth matte. The star field was set up as two levels to provide finer-grained

control in the composite. I was involved with the leveling of these elements, made render pipeline adaptations, and wrote or adapted some of the necessary shaders. In this particular scene the fire and smoke, and some of the smaller debris were done traditionally. I did the CG cleanup for everything else.

This scene was one of the most time-consuming I worked on due to the amazing squash and stretch in Rob Bekuhrs' animation of the cruisers both during and after the crash. While entirely appropriate from the standpoint of the animation, and of the integration for that matter, such extreme distortion wreaks havoc on the so-called “normal” CG work flow. Models and rigs have to be broken, surfaces interpenetrate and seams open up, cheats and shortcuts are revealed, textures stretch, and the rendering programs (especially for ink lines, in this case) make sure you can see every one of those artifacts. Since this was the only cruiser scene with such extreme animation, it didn't make sense to increase the complexity of either the base models or the ink line software. This scene was allowed to have unique models, and I simply painted the remaining objectionable artifacts out of the images. Also, this scene is one of a small handful where the CG Stitch stand-in model was used in the final renders, due to the animation of the red cruiser (and its dramatic change in perspective), and the size on screen.



Source: *Mulan*

CG elements: hun charge

Description: The hun charge was from the outset the major CG element in *Mulan*. The difficulty was no off the shelf animation package of the time could effectively handle the quantity of data associated with the plans for the hun charge. With trimming the hun charge down not considered an option, we were faced with building

a system that could get the job done. We used an extensively modified version of the crowd simulator that was used on *Lion King* and *The Hunchback of Notre Dame*, and built from scratch an editor that could manipulate every single channel of data. The animators would use the simulator to get the basic distribution and flow they needed for each scene, and then would transition into the editor to perform the detailed choreography and costuming. We used a paper-doll metaphor for the hun charge, and through the editor the animators could control every detail of every hun (color palette, hats, swords, shields, scale, left- or right-handed, etc.). Few people know that there was in total actually only one horse model and two hun models (one thin, one more barrel-chested). However, with all the combinations of color, outfit, weapons, shields, and animation behaviors, we calculated there would have to be nearly 400,000 huns in a given scene to guarantee two were completely identical on any particular frame. This was the decisive advantage of the paper-doll metaphor in terms of economy of representation.

I was deeply involved with the hun charge element from the design of the logical structure that created the paper-doll metaphor and the state machines that defined the animated behaviors and their relationships, to the design and implementation of the software, to look development, to CG cleanup on a number of scenes. I did work on the simulator, but most of my software energy went into the editor with key contributions in the areas of usability, the implementation and verification of the combined 2D/3D camera, leveling and pipeline issues for rendering, general optimization, and several procedural modeling and animation solutions. It was convenient that I also worked the procedural modeling and animation issues from the look development perspective, as this afforded me a more holistic viewpoint. Examples include the modeling and animation of the reins, the procedural geometry and shaders for both the shadows and the snow trails, and the modeling and animation of the swirly snow kick up (including the creation of the swirly shader). The huns were rendered with seven levels, including ink lines, paint, shadows, snow kick up, snow trails, and z-depth.

It is also interesting to note there was only a single, 13-frame cycle to the particle animation that made up the swirly snow kick up. Because we used spheres for the geometry, and the shader drew the swirls based on where the sphere was with respect to the camera, and the spheres overlapped and were mostly transparent, even if two distinct horses happened to be on the same frame of the cycle the swirls would still look different. This was another good example of economy of representation.



Source: *Mulan*

CG elements: hun charge, background element

Description: This is another hun charge scene for which I did the CG cleanup on the huns. This particular scene was problematic in terms of the depth complexity associated with the camera angle and the swirly snow kick up, and ultimately was broken down in such a way there were three layers of huns, each with its own set of

rendered levels, that were then reassembled in the composite. This camera angle was also problematic in that the renders revealed a cheat on the geometry of the huns. To save time and cut down on the quantity of data, there was no geometry built for the body parts that were always under the tunics of the huns (particularly no hip region), since they would “never be seen”. As it turns out with the camera this low, the flapping animation of the tunic revealed the cheat. Since this was the only such scene, it made no sense to deal with adding geometry and having to worry about animating it. The objectionable artifacts were painted out.

I also wound up painting a background element for this scene (the ground the huns are running on). Clearly, the camera move in this scene has a 3D component. Tests with this camera move over 3D huns and a 2D background element were less than successful, particularly because the camera move was almost directly into the artwork. We needed a subtle change in perspective on this level, so I painted a texture and applied it to the terrain.



Source: *Lilo and Stitch*

CG elements: gantu ship, bug jar, 747

Description: Captain Gantu's ship by itself was structurally similar to the red and blue cruiser elements, having ink line and paint levels as well as several mattes for tones, the cockpit window, the specular highlights, and the jet blast and glow. The big difference was the addition of the glass container strapped to the back of the ship that trapped Lilo, which we referred to as the "bug jar". The bug jar involved seven levels, mostly mattes, and the look was controlled during the composite. The 747 element was made up of ten rendered levels, including ink lines and paint, and several mattes. I was involved with the leveling of these elements, made render pipeline adaptations, and wrote or adapted some of the necessary shaders. In this scene the buildings were traditional backgrounds, and the sparks and debris associated with the crash were done traditionally. I did the CG cleanup, including additional scene-specific mattes necessary for planting the element in the scene. More details on the 747 and the bug jar follow in other scene descriptions.



Source: *Lilo and Stitch*

CG elements: 747

Description: In this scene everything is traditional except for the 747, which involves its normal ten levels plus additional scene-specific mattes necessary for planting the element in the scene. I did the CG cleanup.

The 747 is associated with an interesting story. Many people are not aware of the fact that, as designed, Act III of *Lilo and Stitch* involved the commandeering of a 747 as part of the attempt to rescue Lilo. It also involved a chase that had the 747 flying on a wingtip between the buildings in Honolulu, and the use of the landing gear down against a curved glass hotel to turn the plane. This chase sequence was mostly into color as production cranked along, and was quite funny. At least it was up until close of business on September 10<sup>th</sup>. As of the morning of September 11<sup>th</sup> the world as we knew it had changed, and this gag wasn't even close to being funny any more. Act III and various related bits were pulled back and reworked, and movie-goers saw a red space ship and a chase through the mountains instead. It was the right thing to do, and is a small testament to the crew that the rework could get done quickly, with care, and without breaking the budget wide open. This scene was a color-rush, as it was destined to be in the original trailer prior to the change.



Source: *Pooh's Hunny Hunt*

CG elements: heffalump, honey, hat

Description: The heffalump was one of the CG elements we did in support of Imagineering for an attraction at Tokyo Disneyland called *Pooh's Hunny Hunt*. The setup is you're riding around through heffalumps and woozles in a "hunny pot" when this guy pokes his trunk in and starts drinking up the honey. The images are projected onto a half-silvered mirror, similar to the way they put ghosts in your car with you in the Haunted Mansion. Pretty cool idea, but not entirely trivial to pull off.

We have a semi-transparent character who fills up with a semi-transparent fluid-- not too bad if you're using constructive solid geometry, but we didn't have that option. Some clever matte work gave us more levels than we'd ordinarily try to use, but achieved the effect. There was also the fact this was projection of video (and we all know what happens to colors with NTSC). This was aggravated a bit when the word came down to change the heffalump's base color from blue-gray to red. Further, this particular projector was being custom made for the attraction, and being shipped directly from the factory to Tokyo. We would never have an opportunity to run tests with the projector, or the mirrors for that matter, and were basically running blind. In terms of logistics, the imagery was going to be shipped to Tokyo where the Imagineers would do the testing, and tell us over the phone what needed to happen. Then we'd make changes and send another test. Clearly, this setup was asking for some difficulty. Finding the right color combination could turn out to be like looking for a needle in a haystack, blindfolded.

The structure I created for the heffalump included a total of 21 rendered levels, most of which were rendered in gray and used as mattes. The composite built up some necessary levels through combinations of the mattes, manipulated the opacities, and wiped in the colors. We also pulled a trick from traditional photography and wedged several color combinations (providing several composites instead of one). This way instead of chasing colors, like “a little less red”, they could give us meaningful corrections like, “about a third of the way between number 2 and number 3.” In the end we never had to re-render the animation to resolve color or projection issues, and only had to run the composite one additional time to make the correction. A little extra setup work on the front end, but pretty much a slam dunk on the back.



Source: *Mulan*

CG elements: palace crowd, fireworks, faux plane

Description: The palace crowd element involved the second incarnation of the crowd software we had developed originally for the hun charge. The question came down, about six months before the end of production, whether or not we could handle about 60 scenes in which the palace crowds were “alive”. These ranged from

relatively closeup to one shot that had 30,000 animated characters in the crowd. It turns out that we attacked this problem from the standpoint of our successful handling of the hun charge, and we took the existing software and removed a lot of things and added some other things, and made a version that could handle palace crowds. For this, the animation was actually done by the traditional folks, based on the specification I gave them for the behaviors and how they were related. Once the animation was approved, we created various textures based on that animation. These gave us the ability to mix and match, change color palettes, etc.

I was deeply involved with the palace crowd element from the design of the state machines that defined the animated behaviors and their relationships, to the adaptation of the software, to look development, to CG cleanup on a number of scenes. The crowd was typically handled with just two main rendered levels, one with the color (which in this case included the linework), and one for z-depth which we used to modulate color and blur, creating an atmospheric effect. I did the CG cleanup for the crowd on this scene.

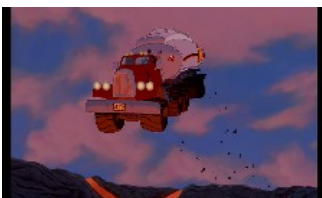


Source: *Lilo and Stitch*

CG elements: gas truck, Stitch

Description: The gas truck was the second CG truck element to go through production, and I had primary responsibility for the look development on it as well. I leveled this element, made render pipeline adaptations, and wrote or adapted some of the necessary shaders. There were twelve rendered levels, counting all the mattes,

and I did the CG cleanup on all the gas truck scenes. This particular scene is one of a small handful where the CG Stitch stand-in model was used in the final renders, due to the bouncing animation of the gas truck, and the size on screen.



Source: *Lilo and Stitch*

CG elements: gas truck, Stitch

Description: This scene is the one where Stitch jumps the gas truck off the edge of the volcano, and into the lava. It was referred to as the “dukes of hazzard” shot, and was unique from the CG cleanup perspective. There were two distinct color models called out, and so two distinct paint levels had to be set up and rendered. The cooler

colors near the head of the shot were transitioned into the warmer colors near the tail, as the truck approached the burning lava. I did the CG cleanup on the gas truck, and this scene also included the CG Stitch.

Note the multiple color model technique is commonly used in traditional animation, but is seldom used with CG (most 3D types would more instinctively go for a projected-light-from-below in a case such as this). There are subtle differences in coloration between the two techniques, and our constant awareness of integrating CG with a 2D film

led us to favor the 2D approach in this case. Things were complicated a bit because the long axis of the gas truck runs away from the camera, so a 2D matte would not work. Instead I generated a 3D depth matte of a sort, only it ran along the camera's y-axis instead of the z. This way, as each individual part of the truck approached the bottom of the frame, it switched more and more to the warmer color model.



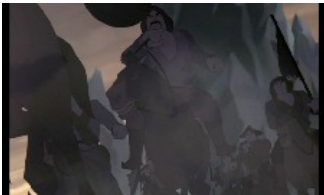
Source: *Roger Rabbit tests*

CG elements: table, hat, roger

Description: Between *Mulan* and *Lilo and Stitch*, we were involved with two Roger Rabbit tests. One involved CG props and a traditionally drawn Roger, and the other included a CG Roger. Since it had been more than 10 years since the first Roger Rabbit film, the basic question was, "Has the technology matured enough to make a

second Roger film cost-effective and relatively painless?" With that in mind the test was set up with a relatively simple story, and specifically included as many hard technical problems as possible. This shot included fairly standard integration of CG with live action issues, but also interaction and lighting obstacles, and a nontrivial camera tracking problem (a long continuous shot with two roughly 180 degree whip-pans, and noticeable camera drift).

I had primary responsibility for the look development on the CG table, including the displacements and some moderately interesting shader work that incorporated dust and smudges, with the goal of not looking like the perfect CG table. I was also responsible for the shader, leveling, and composite structure for the shadows on the table. These were handled as shadow mattes to improve control of color and shadow density in the composite, rather than being rendered directly into the images. I was also involved with several of the shaders used on the CG Roger, the most interesting of which was the set of shaders for Roger's eyes. Due to the basic shape of the eyes, and the exaggerated squash and stretch associated with Roger, it was more effective to handle the eyes procedurally. The color and displacement were essentially projected onto the simple eye geometry, based on a point of interest locator, and additional parameters were included to better match Roger's cartoon-y nature.



Source: *Mulan*

CG elements: huns through the forest

Description: The software we wrote for the hun charge was successful, and scenes were moving through production with relative ease. Story modifications opened up another opportunity to feature the huns on horseback, earlier in the film, as they galloped through the black forest. There was a relatively small number of scenes, but

they would require new animation. With a clever remapping of the logical structure we had used for the hun charge, a few changes were made to the software configuration and virtually none had to be made to the actual software, and only minor changes were made to the budget and overall schedule to incorporate this element. I did the CG cleanup on the huns in this scene, and repurposed the swirly snow kick up here as dust kick up.



Source: *Mulan*

CG elements: huns through the forest

Description: This is another huns through the forest scene for which I did the CG cleanup. There were three layers of huns in this scene (near, mid, far), and due to the extreme closeup on the near horse I had to make several scene-specific modifications.

In particular, both the paint and the ink line renders had a number of objectionable artifacts at this close range. Of course, the camera was never intended to be this close to the huns, but that didn't matter anymore. Since this was the only such scene, and the Director had already approved the animation, we chose not to risk trying to modify both the geometry and animation of the horse. Rather, I reworked textures and tweaked parameters to get reasonably close and then made fairly extensive modifications (especially to the ink lines) by hand to achieve what the Director wanted to see in this scene.



Source: *Lilo and Stitch*

CG elements: gantu ship, bug jar

Description: In this scene, Stitch rescues Lilo from the bug jar just as Captain Gantu's ship explodes. Most of the effects in this scene are traditional, although this is another one-off model since it had to fly apart in the explosion. I did the CG cleanup. An interesting side note here is the shader that animates the glow from the jet blast on the inside of the exhaust assembly. It was used on both the red and blue cruisers, as well as Gantu's ship.



Source: *Lilo and Stitch*

CG elements: sugar cane trucks, rain

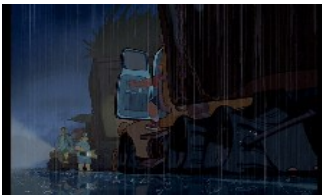
Description: The sequence with Stitch getting run over by the sugar cane trucks came fairly early in the production process, and I had primary responsibility for the look development on the trucks. I leveled this element, made render pipeline adaptations, and wrote or adapted some of the necessary shaders. The trucks were rendered with eight levels, counting the mattes, and I did the CG cleanup on all the scenes with these trucks except for one. These sequence also included particle rain, both falling drops and splashes. I did the CG cleanup on most of these rain shots as well.



Source: *Lilo and Stitch*

CG elements: sugar cane trucks, rain

Description: In this scene, Stitch is chewed up and spit out by the sugar cane trucks. I did the CG cleanup on the trucks and the rain. It is interesting to note this scene is another that includes some pretty extreme squash and stretch. Similar to what was described above for the cruiser crash, extra paint work was required on this scene to remove the objectionable artifacts.



Source: *Lilo and Stitch*

CG elements: sugar cane trucks, rain

Description: This is the most logistically complex of the scenes containing the sugar cane trucks. Each truck is rendered as its own independent set of levels so the depth of the shot can be emphasized in the composite. In addition, there are several levels of traditional artwork (characters and effects) as well as layers of rain sandwiched in between and over the trucks. The twist is the compositing setup is almost constantly changing throughout the shot as the characters run toward camera.



Source: *Mulan*

CG elements: palace crowd

Description: This is another scene for which I did the CG cleanup on the palace crowd element. There were two layers of crowds in this scene.



Source: *Mulan*

CG elements: palace crowd

Description: This is another palace crowd scene for which I did the CG cleanup. There were also two layers of crowds in this scene.



Source: *Lilo and Stitch*

CG elements: genetic guns

Description: The genetic gun element was created as a pair, and were rendered with a total of eight levels, though this particular scene included an additional matte when the gun was “waking up”. I was involved with leveling this element, made render pipeline adaptations, and adapted some of the necessary shaders.

Stitch's encounter with the genetic guns comes early in the film, and this element was a bit different than most of the other CG elements in one specific way. The other elements were “controlled” by the various characters. The genetic guns were “programmed to think on their own.” Darlene Hadrika, who modeled the guns and animated many of the gun scenes, turned their “heads” and blinked their “eyes” to achieve this. I did the CG cleanup on the genetic guns.



Source: *Lilo and Stitch*

CG elements: genetic guns

Description: This is another genetic gun scene, and the interesting thing here is the firing of the guns. The gunfire itself was traditional, including the flash matte, to better integrate with the other gunfire in the film, but the exaggerated squash and stretch helped sell the effect. I did the CG cleanup on the genetic guns.



Source: *Lilo and Stitch*

CG elements: genetic guns

Description: This is another scene with the genetic guns, and immediately follows the gunfire, drawing attention to the Lieutenant's predicament. I did the CG cleanup on the genetic guns.



Source: *Mulan*

CG elements: palace crowd

Description: This is another palace crowd scene, which was used in the trailer. I did the CG cleanup on the crowd.



Source: *Lilo and Stitch*

CG elements: gantu ship, 747

Description: This is another scene from the Honolulu chase sequence. I did the CG cleanup on Gantu's ship and the 747.



Source: *Lilo and Stitch*

CG elements: gas truck

Description: This gas truck scene is set up as a reprise of the earlier composition with the sugar cane truck. Only this time Stitch is ready. I did the CG cleanup on the gas truck and the additional scene specific matte work for the flash across the windshield.



Source: *Lilo and Stitch*  
CG elements: gas truck  
Description: This scene shows Stitch stopping the gas truck, and at the specific request of the Directors emphasizes this truck contains highly flammable material. I did the CG cleanup.



Source: *Lilo and Stitch*  
CG elements: gantu ship, 747  
Description: This is another scene from the Honolulu chase sequence. In this case I did not do the CG cleanup, but rather was called in early on to help figure out the mechanics of how this layout was going to work. I wound up writing some scripts to generate channel data for several of the parameters in the composite.



Source: *Mulan*  
CG elements: hun charge  
Description: This is another hun charge scene, and included some particular rearing behaviors to indicate the horses reacting to the avalanche. I made the necessary changes to support these behaviors and did the CG cleanup on the huns.



Source: *Mulan*  
CG elements: hun charge  
Description: This is another hun charge scene, and is actually the scene I used to convince folks we should be doing the snow trails. As originally planned, the Backgrounds department was going to paint two backgrounds for each scene, one with trails and one without, and the Effects department was budgeted many weeks to

do the tedious job of drawing reveal mattes that followed the running horses and wiped from the clean background to the one with trails. My argument was simple. We were already running a simulation, and had positions for each horse and rider at every single frame. Why not just drop geometry down as each horse moved? Trivially simple for us to render one extra level, and more importantly they'd correspond to exactly where the horses had run. Made the change to the animation system in less than half an hour, and only had to show the change once. It was an immediate hit, saving both Backgrounds and Effects much needed time. I did the CG cleanup on the huns.



Source: *Lilo and Stitch*  
CG elements: gantu ship, bug jar  
Description: This scene is short, but does a better job of showing the bug jar element. The bug jar was composed of seven rendered levels and the traditional characters were sandwiched in during the composite.



Source: *Mulan*  
CG elements: palace crowd  
Description: This is another palace crowd scene for which I did the CG cleanup.



Source: *Lilo and Stitch*

CG elements: genetic guns

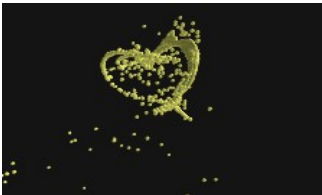
Description: This is another scene with Stitch and the genetic guns, and is the point where Stitch gets the idea for his escape. I did the CG cleanup on the genetic guns.



Source: *Lilo and Stitch*

CG elements: gantu ship, bug jar

Description: This is another shot that shows Gantu's ship and the bug jar holding Lilo. I did the CG cleanup on Gantu's ship and the bug jar.



Source: *swarming particle system*

CG elements: particles

Description: The particle system shown here is one that I wrote from scratch, to tinker with swarming behavior. It was inspired by the ideas behind the bee swarm element we did for *Pooh's Hunny Hunt*, an element for which I played a minor role.

The main idea was to think of the swarm not as a collection of individual bees, but rather as a collective which moved through a constantly changing variety of organic shapes. The purposes of the tinkering are to explore the modifications to a typical particle system needed to support swarming organic shapes, the identification (and preferably orthogonalization) of the additional parameters required, and the mapping of that parameter space in terms of how combinations of parameter values result in particular visual shapes for the swarm. With those things in hand, the obvious follow-on question is gaining sufficient control over the parameters that the swarm behavior can be directed to fit the vision of any particular scene.

An interesting side note here is the shapes the swarm takes are emergent behaviors. The swarming particles (yellow spheres in these images) have no concept of any particular path, nor even any idea there are other particles. Each particle only knows about itself and the target, and only has what amounts to a local perspective of its position and velocity, that is, a fresh calculation is made on every frame. The coherence of any individual path is influenced indirectly by acceleration constraints, and of the swarm as a whole by varying the parameters between particles. Gaussian variation, as instinct might suggest, leads toward organic shapes. There is also a means to introduce some randomness to the paths, in a manner that is conceptually similar to the mutations in a genetic algorithm.

This is very much a work in progress, and in the true spirit of tinkering this is a personal project that I work on only occasionally as time permits between family, work, and various other responsibilities. The exploratory nature of this process, since I only have a general description of where I want to go and I allow myself to follow various thoughts and leads encountered along the way, has a much needed therapeutic effect. I enjoy tinkering with this problem.