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Joe Pasquale
Professor of Visual Effects
Committee Chair

Date

Kirt Witte
Professor of Visual Effects
Topic Consultant

Date

Greg Johnson
Professor of Interactive Design and Game Development
Editor

Date

Invisible Visual Effects: Technological Breakthroughs
Allowing the Creation of Complex yet Subtle Visual Effects for Film

A Thesis Submitted to the Faculty of the Visual Effects Department
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Michael C. Cabrera

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Throughout the history of film, filmmakers have enlisted the aid of the visual effects artist to help tell the story by creating elements, which enhance the visual vocabulary of the motion picture. Visual effects artists have tricked the eye of the audience using everyday objects in extraordinary ways. The challenge for these artists has been to create believable effects that enhance the director's vision yet disappear within the context of the story. An increase in technological breakthroughs within the visual effects industry is providing the opportunity for filmmakers and visual effects artists to create complex yet subtle invisible visual effects for films. In this paper I will define the difference between visible and invisible effects and then compare and contrast the pros and cons of using them. I will examine the process of making invisible effects with regard to the different tools available for their creation. I will discuss several movies that use invisible visual effects and how they were created. Finally, I will talk about my process when creating invisible visual effects.

Visual effects help enhance the look of a movie or create scenery and situations that cannot or do not exist in real life. The two distinctive styles of visual effects are visible and invisible. Visible visual effects are visual effects that are obvious to the audience while invisible visual effects can be so subtle that the scene is realistic and totally convincing to the audience. According to an article by Mary Ann Skweres:

Visual effects have been maturing since those first Academy Awards. Good work is being done on all levels, in all formats and at all budgets. The craft has grown up to play a significant role in the filmmaking process, on a par with the other crafts. Technicians are now artists. Both the art and the technology have advanced. Advances are happening so fast, in fact, that what will be cutting edge in two years is something not seen before. In the future, invisible effects will be the bulk of effects work done. ("Getting Respect for Invisible VFX" n. pag.)

There are several pros and cons to using visible visual effects. The advantages include taking less time and money to produce them with “off the shelf” technology. Since the effects become the star of the show, they can also be used to sell the film during promotion. When it comes to awards for best visual effects, “the big effects-driven blockbusters get most of the attention and acclaim, thanks to their popularity and higher profile.” (“Getting Respect for Invisible VFX” n. pag.) The downside of using visible visual effects consists of the poor quality that cheapens the look of the film and the distraction from the main content of the film caused by the eye candy of the effects.

Invisible visual effects, on the other hand, benefit from the high quality of the effects in the film. The audience is completely unaware the effects exist. Because of this, they cause no distractions from the film, but rather, enhance the vision of the director. Inside the effects world, subtle work not being recognized is considered the best compliment and a special pride is taken. (“Invisible f/x tweak reality” n. pag.) “For second unit director and visual effects supervisor Ted Rae, an important criterion for visual effects is that they fold right into the filmmaking process and are aesthetically part of the storytelling. The drama drives the effects.” (“Getting Respect for Invisible VFX” n. pag.) The disadvantages to creating invisible visual effects include not only needing more time and money for production, where most of the time needed is used to create the proprietary technology to produce the effects, but also more substance to the story itself within the film. “Film makers find it increasingly difficult to impress audiences with outstanding images and have to work even harder to create entertainment in which audiences are genuinely swept up by the drama and intrigued by well-observed characters.” (Rickett 299)

Even though it takes less time and money to produce visible effects, the quality can turn out to be poor due to the tight budgets and deadlines, and most of the time can distract from the film itself. Visual effects supervisor Rob Legato thinks that, “like a new toy, (computer graphics) have been overused and don’t have the impact or production value they once had. ‘There is a backlash from overuse. Now there is a trend toward using more truthful, simpler effects that are shot like a conventional shot.’” (“Getting Respect for Invisible VFX” n. pag.) With invisible effects we can produce high quality effects that do not distract from the film. But the consequences are obvious, more money and more time are needed for the effects to be created. “Given enough time and money, any image imaginable can now be conjured with the computer.” (Rickett 299) With the understanding of the pros and cons of invisible visual effects we can explore the technology that is used in the industry to create these effects.

There are several tools available to a visual effects artist for creating invisible effects, including compositing, computer-generated (“CG”), as well as lighting and rendering software packages. In addition to these packages, proprietary software or plug-ins are written to meet the needs of a particular sequence within the film. The role of all of this technology is to help the director to create his movie with his vision. (“Getting Respect for Invisible VFX” n. pag.)

The use of Adobe’s Shake, After Effects, Autodesk’s Combustion, Inferno, or Digital Domain’s Nuke allows the compositing artist to create seamless integration of CG and live elements into a film. Compositing software delivers a broad toolset for the visual effects artist. These tools include the ability to combine many layers of assets, motion track in both 2D and 3D environments, create alpha mattes from color keys, color correct

any of the assets, and add additional effects to complete the desired result. “Once footage is in a computer, unwanted details may be erased, skies made more dramatic, autumn leaves turned green, crowds of extras multiplied and one actor’s best performance combined with another’s from a different take.” (Rickett 299) In a related article, Estelle Shay writes:

Specializing in 'invisible effects,' Sheena Duggal relishes creating the kind of movie magic that most moviegoers never notice. One of the first four Inferno artists in the world, Duggal was hired by Sony Pictures Imageworks nine years ago to set up and oversee the company's Inferno department, then later transitioned into visual effects supervision. I'm fortunate, because a lot of the types of shots I'm doing can be done in a 2D way. And since I was involved in building this department, I know all the skills of the artists. That's a great advantage to me as a visual effects supervisor." Invisible Woman." n. pag.)

With the advent of high end 3D packages, such as Autodesk’s Maya and Side Effects’ Houdini, artists are able to create and texture “realistic” models for films. 3D software brings a toolset for visual effects artists, allowing the artists the ability to create elements which are not easily controllable in real life. In the past, visual effects were often used for pop films, today we try to improve and enhance the images carefully. “The visual effects artist’s role is also in the area of image enhancement – the addition of invisible visual effects that aren’t noticeable as such. For example a non-existent building on the right of the frame – you don’t see it because it’s completely integrated into the real one.” (“Black Hawk Down: VFX and Postproduction” n. pag.) With dynamics being integrated into 3D packages the artist is able to create visually stunning fluids, explosions, and atmospherics. In the film Elektra (2005), a scene involving leaves falling

as they changed from green to wilted and black was needed. According to the Pixel Magic Visual Effects website:

CG leaves was the approach decided upon as it allowed maximum flexibility over controlling density, color and wilting animation. The CG leaves, created in Maya 6.0, were instanced objects attached to a particle system. Their behavior was driven by a combination of dynamics, expressions, and age-based sequential instancing. Dynamics such as wind and turbulence provided the basic falling, swirling movement. Custom expressions were used to control their rotation rate and wilting effect on a per-particle basis. In addition, a number of leaves were hand-animated "heroes" with special interactive behavior. The setup for the leaves needed to allow the maximum amount of flexibility for the director to control every aspect of their dynamics and appearance". ("Elektra". n. pag.)

Finally, Pixar's Renderman, NewTek's Lightwave 3D Renderer, Houdini's Mantra allow Technical Directors and artists the ability to create complex shaders and match to live action lighting systems to use with high end 3D models. RenderMan's powerful shading language and anti-aliased motion blur allow designers to believably integrate stunning synthetic effects with live-action footage. (Pixar's Renderman Products. n. pag.)

With an expert understanding of these technologies, visual effect supervisors and visual effects artists can create complex, yet subtle effects for films using these and other packages. By writing their own proprietary software and plug-ins, artists are able to push the envelope on what is considered an invisible effect. Without the dedication of both the visual effects supervisor and the visual effects artists, the idea of creating invisible effects with these toolsets would simply just be creating visual effects. Visual effects supervisor Gray Marshall explains:

“From our point of view, the reason to do this is not to make effects, but to enhance the story. If the film does well, we’ve done our job.” Marshall admits receiving Oscar recognition would be nice, but more important to him is recognition from the directors, cinematographers and editors that the company has worked with. That’s because new projects usually come from clients who have been pleased with past collaborations. In the last few years a number of movies have gone about creating visual effects using breakthrough proprietary plug-ins and software. (“Getting Respect for Invisible VFX” n. pag.)

To demonstrate the use of these toolsets, the following section explores several movies that use invisible visual effects and how they were created.

In *Master and Commander: The Far Side of the World*, there are several sequences that are a prime example of invisible visual effects. Set on the high seas, the story is about Lucky Jack Aubrey, a captain whose ship is suddenly attacked by a much superior enemy warship. For the first time, because of advances in special effects, audiences feel what it’s really like to be in the heat of the battle and the heart of the storm. (“Master and Commander: Behind the Scenes Feature” n. pag.) The beetle crawling sequence (Fig. 1) uses CG and live action compositing, lighting and texturing techniques, as well as realistic animation. CG was used so that the beetles’ actions could be completely controlled for the director’s vision. This sequence was created first by shooting the live action plates and then creating the CG elements to match the camera angles and movement. The bird flying sequence (Fig. 2) uses slightly different elements because the live action of birds was composited into the live action of the environment. Similarly, the storm sequence (Fig. 3) was composited but, for the first time ever, real footage of an actual storm was combined with live action miniature and CG ships to create a typhoon that looked as real as it was big. “Peter Weir’s mandate for the film’s

state-of-the-art visual effects work, comprising some 750 shots, was that they be 'invisible' – no matter the amount of research and development, artistry and man-hours that went into creating the effects.” (“Master and Commander: Behind the Scenes Feature” n. pag.)

The Last Samurai is set in Japan, while Civil War veteran Captain Nathan Algren trains the Emperor's troops to use modern weapons as they prepare to defeat the last of the country's samurais. But Algren's passion is swayed when he is captured by the samurai and learns about their traditions and code of honor. (“Plot summary for The Last Samurai, 2003.” n. pag.) In *The Last Samurai*, the sword fighting sequence (Fig. 4) and the arrow shooting sequence (Fig. 5) were both shot as live action scenes, but CG elements of the arrows and the swords were added to create the dramatic effect and prevent the actors from being harmed. The director of the film, Edward Zwick, was most impressed with the fact that no one, not even a horse, was hurt during the filming process. He credits this fact with the extensive special effects elements that were added during the film's battle scenes. The Samurai were required to be on horseback while shooting arrows into a crowd of hundreds of people. The use of real arrows would have been too much of a safety issue, so they were added into the sequence with computer generated imagery (“CGI”). To aid in the accuracy of sight-line reactions from the actors, real arrows were hand thrown during a scene. The arrows were then physically attached to any actor that was hit for the duration of the scene. All of the physical arrows had to be hand-painted out and their position was used so that CG arrows could be integrated seamlessly. (“Flash Film Works delivers epic effects to enhance grandeur of The Last Samurai” n. pag.)

During the sword sequences in *The Last Samurai* with Tom Cruise, a retracting prop sword was used during the filming which then had to be painted out and replaced with a CG sword. In order to have reference in tracking the CG swords and spears, tracking markers were placed on the soldiers that would be stabbed. Then the 3D camera was tracked to match the movement of the live-action camera. Because there were so many soldiers moving through the frame, the markers were constantly being obscured so most of the camera tracking was done by hand. Once the camera movement was matched, the soldiers' torsos could then be matchmoved, allowing a link between the animation of the sword and the torso of the victim after being stabbed. This also made the accuracy of shadows and reflections possible. When it came to matchmoving Tom Cruise's sword, there was another problem that needed to be addressed. The sword handle rotates unrealistically in the footage because it is difficult for an actor to simulate a sword being stuck into another body and react to the movement that follows. Because of this, there were times when the blade or the whole sword needed to be replaced to make the shot work. ("An interview with Justin Mitchell (Digital Dimension) on the Last Samurai." n. pag.)

The visual effects artists do not usually tell the story. They hear it from the person who wants to tell one and then think about how it can be accomplished. If they do not get involved with the story, then they cannot work constructively with the director or the visual effects supervisor. Taking care of the technical aspects and how to realize them usually allows new possibilities to emerge that enable the director to do things they had previously thought unworkable. ("Black Hawk Down: VFX and Postproduction" n. pag.)

With this inspiration, I have developed my Thesis project to explore my own personal artistic understanding of invisible visual effects.

With my thesis project, I have explored the idea of adding CG elements to live action footage to enhance the aesthetic value within two sequences of the short film, “Bottleneck,” directed by Andrew Shippides. One of the shots contains elements that, in the real world, are small and difficult to capture on film. Both shots deal with full CG integration of elements that did not physically exist in the real world. By using visual effects, the ability to introduce these elements into the footage enhances the overall experience for the audience.

The first sequence from “Bottleneck” in which I contributed CG elements begins as the camera, from the viewpoint of a man, moves through a crowd of people at an outdoor party in a garden. Coming to a stop and focusing on a 12-foot genie-like bottle, we see a girl inside floating in water. The people around seem oblivious to her. A tall man then walks into the scene and stops at the bottle. The visual effects needed in this sequence (Fig. 6) was to include a woman that was shot at high speed on green screen into a CG bottle filled with water that is then motion corrected to match a dollied live shot of the party. The background plates for the short film were shot in high definition (HD) format.

For this shot, the woman was filmed against a greenscreen at 96 frames per second (fps) on 35 millimeter (mm) stock film. Taken in a closed studio, the visual effects supervisor, Daniel Kruse, and I were present to verify her placement in the shot. Once we had the footage back from production, I started modeling the bottle in Maya. Once the modeling of the bottle and the surrounding vines were completed (Fig. 7), I

used procedural shaders to create the textures for the vines (Fig. 8). Dan used a similar approach to create the glass shader for the bottle.

The compositor, Josh Shueman, created a camera in 2d3's Boujou, an automatic match moving application, to match the live action shot. To create the integration of the bottle into the background plate, a high dynamic range imaging ("HDRI") chrome ball was shot at the same time the background plate was filmed. I created an environment map by using the practical shot of the HDRI information. By using the HDRI lighting, the environment map, and importing the camera information into Maya, I was able to tweak the lighting and create multiple render passes for the compositor to have control over the look and feel of the bottle and the vines. The illusion of the actress floating underwater is then created when the woman was composited "into" the bottle. Josh created the composite by layering the plates of the actress, the bottle, and the addition of the water, which was created as a post effect in Shake. All layers were color corrected to match the live action sequence.

The second sequence from "Bottleneck" (Fig. 9) in which I contributed CG elements begins as a young girl is sitting at her school desk in a classroom with her hands extended holding an origami flower. Water is poured onto the flower and it blooms.

This sequence was first explained to me as a replacement shot from a live action paper flower to a CG one that blooms. A live action plate was filmed with real water being poured onto the real paper flower, filming was then stopped and the paper flower was removed. A clean plate was then filmed for the CG replacement. After a number of meetings, our visual effects supervisor, Daniel Kruse, decided that it would be best to

create this sequence using all CG. Our modeler on this shot, Brian Bentley, went about creating the model and animated the “blooming” of the flower. A procedural and image-based texture was created by Daniel Kruse to give the flower the look of paper. I then set to creating the CG water for the shot. After a number of trials using different software, I finalized the water mesh using Next Limit’s evaluation version of Realflow. I imported the mesh into Maya using the plug-ins, and then applied and tweaked a procedural glass shader to give the look of water (Fig. 10). I rendered the flower and water separately to, once again, give the compositor control over the final look and feel that would be needed. Both plates were composited together and color corrected to the film stock.

The opportunity for filmmakers and visual effects artists to create complex yet subtle invisible visual effects for films has been evidenced by an increase in technological breakthroughs within the visual effects industry. I have defined the differences between visible and invisible effects and compared and contrasted the pros and cons of using them. I examined the process of making invisible effects with regard to the different tools available for their creation and I discussed several movies that use invisible visual effects and how they were created. I have taken the challenge to create believable effects that will enhance a director’s vision yet disappear within the context of the story. I conclude that future films will contain more invisible effects with the use of not only the technologies I have discussed, but also the technologies that will be available to both visual effects supervisors and visual effects artists in the future.

List of Figures



Fig. 1. Master and Commander: The Far Side of the World, Dir. Peter Weir, “Beetle Crawling” 20th Century Fox Films, 2003.



Fig. 2. Master and Commander: The Far Side of the World, Dir. Peter Weir, “Bird Flying” 20th Century Fox Films, 2003.



Fig. 3. Master and Commander: The Far Side of the World, Dir. Peter Weir, “Storm” 20th Century Fox Films, 2003.



Fig. 4. Last Samurai, The, Dir. Edwards Zwick, “Sword Fighting” Warner Bros., 2003.



Fig. 5. Last Samurai, The, Dir. Edwards Zwick, “Arrow Shooting” Warner Bros., 2003.



Fig. 6. Bottleneck, Dir. Andrew Shippersides, “The Bottle” Savannah College of Art and Design, 2006.



Fig. 7. Bottleneck, Dir. Andrew Shipsides, “The Bottle” Savannah College of Art and Design, 2006.



Fig. 8. Bottleneck, Dir. Andrew Shipsides, “The Bottle” Savannah College of Art and Design, 2006.



Fig. 9. Bottleneck, Dir. Andrew Shipsides, “The Flower” Savannah College of Art and Design, 2006.



Fig. 10. Bottleneck, Dir. Andrew Shipsides, “The Flower” Savannah College of Art and Design, 2006.

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