History of Visual Effects and Filmmaking

Abstract

This PDF is a condensed overview of the following articles:

- Storytelling and Sound in Cinema
- Why do Artists Use Houdini?
- How has Visual Effects Changed Over the Past 20 Years?

- In this summarized PDF we will be talking about the history of visual effects over the past 20 years, and how to properly use visual effects to tell a story. Plus, a quick history lesson on my favorite software.

When we create abstract effects in film, television or games, it is even hard to communicate what the story behind the effect is. So here is a quick breakdown on storytelling and sound.

Storytelling 101

Let's go back to the basics. There are six elements to a story.

Setting:

- The setting is the time and location in which your story takes place. Settings can be very specific, but can also be more broad and descriptive. Setting sets the mood of your story. For example, an open background of a field while it downpours in the middle of the night might convey a different visual than a pan through New York City.

Characters:

- There is always a protagonist and antagonist. if you are working from a VFX perspective, this might mean a good effect or a bad effect colliding with each other. The protagonist is the main character of a story. While antagonists oppose protagonists, standing between them and their ultimate goals. The antagonist can be presented in the form of any person, place, thing, or situation. There is no limit on how many characters can be in a story.

Plot:

- The plot is the sequence of events that connect the audience to the protagonist and their ultimate goal. There is always a clear goal in every good story.

Conflict:

- The conflict is what drives the story. If there's no conflict, the audience will not care, but there will be no compelling story to tell. Conflict is what engages an audience.

Theme:

- The theme is what the story is really about. It's the main idea or underlying meaning. There can be a few different major themes and minor themes throughout a story.

Narrative Arc:

- A strong story plot has a narrative arc that has four important parts.

- *Setup.* This is the world in which the protagonist exists prior to the journey.

- *Rising Tension.* The series of obstacles the protagonist must overcome.

- *Climax*. The point of highest tension in the story.

- And *Resolution*. The conflict's conclusion.

Direction and Characterization in Film

There are a lot of topics we could cover under this umbrella topic. There is a huge section I will briefly mention on how actors characterize their performance in film. But I'll be honest, I'm more interested in how we convey characters at a production level.

Let's start with our actors. Each actor in a film for a main role research's topics that is linked to their character in their film. They create a method of how to best approach that character's movements and persona. If a character walks with a limp, it's the actors job to make that limp believable. An actor should care about their character. Otherwise, the story of that character's actions won't be believed.

However, in order to match our scenes with the tone of our character's dialogue and actions we need to create the correct atmosphere. There are several elements to do this.

The Soundtrack

- This element includes both dialogue and music, as well as all the other sounds in a film. This enhances the atmosphere of the film based on the theme of the music. Usually, any background music will help accentuate interesting moments in the film.

Camera Usage

- A camera shot is based on the camera's distance from the object. There are four main shots that are used in films. These are: The close up, A medium shot, full shot, and a long shot. All of these shots help tell the story based on how the audience is viewing the character, or how the character is viewing the events around them. Shots also contain angles that help create a better perspective on the story. Some of these are: straight-on angle, high angle, low angle, and oblique angle.

A good question to ask while creating or moving your camera is: Does the camera say anything about the character?

Lighting

- Lighting focuses the audience's attention on the main character or object in a film. It also sets the mood or atmosphere. Special lighting is used during important scenes. High-key lighting is bright and illuminating, low-key lighting is darker with a lot of shadows. Filters are often used to soften and reduce harsh contrasts. They can also be used to eliminate haze, ultraviolet light or glare from water when shooting outside.

Editing

- Editing is the way in which a film editor together with the director cuts and assembles the scenes. The way the scenes are joined together creates the rhythm of the motion picture. Scenes can be long and drawn out or short and choppy.

Storytelling in Visual Effects

Now before we go into how visual effects can help improve a story, I need to give a few examples of how it can backfire. So let's talk about Star Wars. Or at least, the prequels and all the 90s edits.

When Star Wars Episode 1 The Phantom Menace was released, it was a huge success for Lucas Film. It had a huge opening weekend, and the effects were fairly good for it's time. It had state of the art CGI, incredible music, mind melting sound design, and a light-saber battles galore. But story wise it sucked.

In fact, one could argue all of the prequels lacked a huge storytelling element, and are recognized as some of the worst Star Wars movies. So why is this?

The prequels are not based around the character's story, but they hinge around VFX to *be* the story. This is not a good idea for any film.

But, is it possible to do both? Can you use visual effects, 3D animation,regular storytelling, and still create a great film? Yes.

Now let's talk about the film Gravity.

If you've never seen Gravity. Quick summary. It's about two astronauts trapped in space, and things go terribly wrong. So the whole set is in an environment that is CG. Visual effects are used as a function of the story, while the characters use the visually affected environment to develop the story. In that context, visual effects work.

A powerful story can be supported, and enhanced, by powerful visuals. Even when films are seen as blockbusters, digital effects can add visual identity to the story to make it unique.

Evolution of Visual Effect Techniques

The earliest visual effects were produced within the camera. This included simple jump-cuts and superimpositions, miniatures, back projection, and matte paintings. Optical effects came a bit later as this was a hard effect to produce. These effects were, using film, light, shadow, lenses, and chemical processes to produce the film effects. Even later these effects would evolve into film titles, fades, dissolves, wipes, blow ups, skip frames, blue-screens, compositing, double exposures, and zooms.

Cell animation, scale modeling, claymation, digital compositing, and animatronics would also evolve from the need to create realistic effects. As well to better connect the viewer to the story. The use of prosthetic makeup, and computer graphics are just some of the more modern techniques that we use today.

How Has The VFX Industry Changed?

Because it's now been officially two decades since the start of the century, I thought it might be fun to look back at the industry twenty years ago. A lot of the information listed here will be about turning points in VFX, and how our jobs developed over time.

I also want to place down a little disclaimer. By no means was I working in the VFX industry 20 years ago. But I think it's highly important to understand and pay respects to our colleagues who have, and to the industry that was. So let's learn more about our history, and how our current jobs came to be. This article won't be covering everything that has happened pre 2000s, but I will do my best.

What Was Happening in Visual Effects 20 Years Ago?

A lot. A lot of things were happening 20 years ago......Let's fly back all the way to 1997.

1997 - Marvin the Martian in the Third Dimension, was a 12-minute Warner Bros film. It opened as a feature of the Warner Bros. theme park in Australia. It was the first computer-animated CG film that

was to be viewed with 3-D glasses. Around this time, DVDs (Digital Versatile Discs), became the new generation of optical disc storage technology. It also began to be sold to consumers.

1998 - DreamWorks Antz became the first computer-animated film to receive a PG rating. Up until this point, animated films had to be PG-13 or higher. It was also the first computer-animated feature film to use computer software to simulate and make CGI water.

1999 - The first of three Star Wars prequels (released from 1999-2005); Star Wars: Episode I -The Phantom Menace opened and became the top grossing film of 1999. It also featured a completely CGI-generated main character named Jar Jar Binks. It is widely considered one of the worst sequels/prequels of all time. This was also the debut year of the popular personal digital video recorder (PVR or DVR). It had the capability of recording movies and episodes of favorite programs, quickly skipping past the commercials and even pausing and rewinding live TV. Also debuting this year was Disney's animated film Tarzan. According to Guinness World Records, Tarzan was the most expensive film produced in animation till the release of Treasure Planet (2002). It was the first film to use a 3-D painting and rendering technique dubbed 'Deep Canvas', which allowed 2D hand-drawn characters to exist in a 3D environment.

2000 - The first live-action feature film to be entirely digitally color-corrected (or color-graded), was the Coen Brothers' O Brother, Where Art Thou?. It was the first film in its entirety to be graded digitally on computer, by scanning in the whole film and then digitally coloring it. Also during this year, the movie The Perfect Storm developed FX techniques of depicting digital water. It used advanced software that both realistically displayed life-like droplets of water as well as the large waves of the raging ocean. No miniatures were used in the film. Everything was CGI.

2001-2003 - In Peter Jackson's Lord of the Rings (2001-2003) trilogy debuted. The largest battle sequences involved more than 200,000 characters, and were created by MASSIVE software (Multiple Agent Simulation System in Virtual Environment) developed by New Zealand's Weta Digital. It also used Artificial Intelligence to depict the independent movements of each of the characters in the scenes. Final Fantasy: The Spirits Within (2001), became the first fully computer-generated feature film with photo-realistic characters. For the time, it had one of the most complex CG human characters ever created. This was the character Dr. Aki Ross, who was reported to have 60,000 individual strands of hair. The film also pioneered and successfully used full-motion capture technology. At the time of its release, it was the most-expensive video-game-inspired film ever made.

VFX Innovations

Most of the innovations through visual effects come through filmmakers being challenged in their film-making process. They also come from demands from clients, and the stress of trying to create something that has never been down before. Listed below are some films, games, and moments where teams of artists were challenged and managed to develop a better process of making CGI.

Transformers: Age of Extinction(2014)

In the entirety of the Transformers franchise, conveying the size of the characters had always been a challenge. However in this film, the biggest challenge was developing the scale for the Knight-ship. ILM was tasked with figuring out a way to convince the audience that this spaceship was larger than the Earth, as well as making it render-able for their servers. Using a bunch of different techniques, they were able to render a ship, but make it seem larger than life by playing with the scale of the Earth's atmosphere.

Battleship(2012)

In this film, most of the film took place on the oceans. But the majority of the film was in CGI. The filmmakers needed to convince the audience that the water in film was real, and the characters were in some actual danger. They also needed to save their render farm from dying from too many water simulations. Using a new ILM only water rendering technique, they were able to render at a much faster rate than before. Some of the shots required rendering hundreds of millions of individual droplets of water.

Star Trek Into Darkness(2013)

City simulations can take a long time to build. As well as a long time to render, texture, and pan through. So building and creating a futuristic city for Star Trek was difficult. ILM once again stepped up to the plate, and dug their heels in. They decided to make a futuristic version of San Francisco, and they analyzed modern urban design to determine how a futuristic society might look different from a modern one.

Rogue One(2016)

Rogue One proved that you don't need to use a blue screen to add computer generated elements. Considering that most of the film involved spaceship, aliens, CGI characters, explosions, and more...This was quite a feat. It managed to do this through using different tracking elements, and AI software. Essentially, they lined up elements with the use of computerized tracking and virtual cameras. Knowing that CGI backgrounds can now move in relation to a virtual camera based on camera/lens metadata fed into the computer, the artists were able to operate cameras in a virtual environment. If this sounds a bit complicated, then think of a character running around in a video game. You are controlling that character, and you are viewing the story from that character.

Present Day

This past year has been difficult to say the least. The corona-virus pandemic caused havoc for the film industry. Almost all major films and TV shows were postponed. Movie theater closures went into effect throughout the world, and a predicted global box-office loss was about $17 billion for the film industry. Overall, this year has really limited our development as artists and our field's growth. But I

think a good decision for all of us would be to take a look back on the development of ourselves, and where we stand in this industry. If we can't grow in our jobs, let's look at ourselves outside of it.

In the wake of mass protests over racist police behavior, streaming services limited and cut ties with shows that are now not acceptable for their content matter. Such as HBO temporarily removing the classic Civil War historical drama-romance Gone with the Wind from its library. Now more that ever we need to be self aware as artists and understand what we are creating in the world, and how our actions will affect others.

The 2010s was also the first decade since the 1960s, with zero female writing Oscar winners.

Looking back on the previous two years, we can also say that our media is continuing to grow. In 2018, The domestic box-office totals reached $11.9 billion for the first time, and the worldwide box-office totaled $41.7 billion.

We can also say that some good representation has happened. In 2018 as well, Ava DuVernay became the first African American woman to direct a live-action film with a $100 million or more budget. (A Wrinkle in Time (2018)) 14% of the directors of the top 100-grossing movies in 2018 were black, according to a report by the USC Annenberg Inclusion Initiative. Keep in mind, that is a low percentage, but I like to think we are making progress. Let's bump it a bit higher. :)

A "Brief" History of Houdini

Houdini or PRISMS as it was called back in the day, was created in 1987. PRISMS was a software combination of C programs that a company called Omnibus was using at the time. The creators of SideFx; Kim Davidson and Greg Hermanovic then decided to take this software that they had created using these programs, and throw it into the world of computer graphics. PRISMS had a few versions of development before it was called Houdini. This is a summarized list of events:

- 1.0 Published 1987: A new motion editor and modeler added.
- 3.0 Published 1990: Mantra is Born! Ray tracing is now available!
- 4.5 Published 1991: The heart of all simulations...Particles are here!
- 5.1 Published 1991: A full blown graph system is completed.
- 6.4 Published 1997: Compatibility for the SGI O2 Unix Workstation is created. Around this time, the first sci-fi tech Oscar was awarded to Greg Hermanovic, Kim Davidson, Mark Elendt, Paul Breslin.
- 7.0 Published 1998: PRISMS final release before the new Houdini era.

- Now that we have a set time line for PRISMS, let's quickly create a summarized one for Houdini before we dive a little deeper. Here is the current(as of March 2020) timeline:

- <u>1.0 Published 1996</u>: While PRISMS is still being used in productions, Houdini is presented at SIGGRAPH. The price for one Houdini license around this time is $9,500. Nurbs rock your world. 3D and 2D tools Integration. Scripting and expression language are developed.
- <u>4.0 Published 2000:</u> Linux support is added. The price for a license around this time is $17,000. Resizable panes are now an option. Mantra updates are made. A Linux port is also here for a while
- <u>7.0 Published 2004</u>: IRIX support is no longer available. RenderMan support is added. Character tool improvements are made. RSL VOPs are here. The Channel List and Dope Sheet are added.
- <u>10.0 Published 2009:</u> Pyro FX are available! You can now crumple and tear cloth with more ease. PBR is now in existence. Progressing Interactive Photo-realistic Rendering is also added. Sticky notes are here for those trying times.Shift/Ctrl movement shortcuts make things a lot easier.
- <u>11.0 Published July 2010:</u> FLIP Fluids are created. Dynamic fracturing such as Voronoi is available. The Material Shader Builder is here. The view-port now supports OpenGL Effects for volumes, lights, and normals.
- <u>13.0 Published October 2013</u>: FEM Solver is added. You now have the ability to pack primitives. Particle systems now exist as DOPs. The Debris Shelf Tool is here! OpenSubdiv is available.
- <u>14.0 Published: January 2015:</u> Crowd solvers are now available. The PBD Grain Solver is also added. New Color Picker is added. Material Style-sheets are a thing. Attributes can now hold arrays. Hair Grooming is available.
- <u>16.0 Published February 2017</u>: You can change and customize the shapes of nodes. A new network editor is created. New architecture for procedural terrain generation is a thing. Extensive OpenCL support added. Enhancements to the Animation Editor. A Complete overhaul of hair and fur creation, grooming and rendering is made. (There is much more...)
- <u>17.0 Published October 2018:</u> Vellum is created! The whitewater solver is here so your water looks better. Advanced tools are added to terrain creation. UV workflow tools are expanded. The retime SOP is here. Updates to the Houdini engine are made and character animation tools.
- <u>18.0 Published November 2019:</u> Solaris is created! Upgrades to the FEM system. Sparse Pyro is available. SOP-based tools for configuring Destruction and Pyro FX shots are added. .

A lot of Houdini's tools were first developed by SideFx interns and employees. <u>Coen Closters, a</u> Dutch intern, developed what came to be known as the pyro tools in the software. <u>Nick Van Zutphen</u> also had the personal joy of wanting to learn more about the program, and ended up developing a new FLIP fluid solver. Interns have always played an important role at SideFx, and always will.

There are so many others who work tiredly at SideFX to make our lives in VFX easier. I'd love to mention all of them here, be it might be impossible to document all of them at once. But to all of them, let's give them a huge hug.

Sidefx has also received the Academy Award of Merit four different times. Once in 1997, 2002, 2011, and 2018.

When Houdini was first released in 1996, it was marketed as the "*first non-linear 3D animation environment*". Which basically meant; if you need a different structure to build something in, we've got the tool for you.

Houdini also showed very quickly it could surpass its founding program PRISMS. PRISMS was limited to the hardware limitations at the time. Houdini was able to be adapted from the procedural systems of PRISMS, and as well introducing its own rendering system that would feed off concepts from Render-man. Houdini was able to grow from just a SOP based program like PRISMS, and develop more variations of DOPs and combinations of nodes.

What Does Houdini Do Differently From Other Softwares?

I'll use Maya for comparison. Simply because it's the most used software in the industry for animation and development.

Maya's first release was in 1998, and Houdini's in 1996. They were generally released around the same time. But one arguably took off quicker than the other. Why? Many could argue that because Maya was bought out in 2005 by Auto-desk,and it was marketed more heavily. Whereas Houdini has been property of SideFX from the very beginning, which was a smaller company. But does this make one better than the other?

No. Each software does their job differently , and quicker depending on the task. It really comes down to how the artist uses the software to their advantage, and adjusts to the UI.

So putting that aside, let's dive into the overall differences.

Maya and Houdini run off of two different scripting languages. Maya runs off of RSL(Render-man Shading Language), and Houdini runs off VEX. Maya is fairly more straightforward to learn than Houdini. Whereas Houdini has multiple different approaches to learning the software. This is very dependent on what you would like to use Houdini for.

You can also customize Maya more than Houdini. This is because Houdini's workflow is very different from most animation softwares. Because Houdini is built around the idea of proceduralization, the software expects you to keep that idea in mind while working with it. With Maya, the software works with every project being different, and you'll need flexibility to make them completely different. For example, Houdini has flexibility in copying and replicating environmental models, but sculpting a character is a harder task than modeling it in Maya or Zbrush.

Maya is also more built around the concepts of animation, modeling, and texturing. Houdini's is built around visual effects, rigging, lighting, and compositing.

In conclusion, these are both amazing softwares. No need to start a software war. Enjoy what we have, and keep exploring the options you have as a VFX artist.