The History of Computer Graphics and Effects
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From the very early days of man's creation it seems he has been fascinated by the world around him. Early cave paintings show the very first artistic expression of man's desire to represent this world, showing not only the very form of creation but the living qualities of movement as well. This art form has been developed and diversified over the centuries until the establishment of the motion picture industry in the late 1800's. The first ever special effect or 'Illusion' as they were known then, was produced in 1895 by Alfred Clark in *The Execution of Mary Queen of Scots*.

1900's and 1910's

Around the turn of the century, the French magician George Méliès released his first film *Indian Rubber Head* (1901) bringing his own form of magic to the big screen. The following year he released *A Trip to the Moon* (1902) and *The Dancing Midget* (1902), using almost every type of special effects trick used today.

George Méliès: A Trip to the Moon

Effects continued to become more elaborate throughout the next twenty years, through people such as Robert W. Paul and Edwin S. Porter. The technique of using Mattes to composite several images onto one negative was employed in such films as *The Great Train Robbery* (1903) and *The Motorist* (1906).

1920's

By the mid 1920's things began to change. Willis O'Brian's Stop Motion hit theaters in 1925 in the form of *The Lost World*, while a year later Fritz Lang's *Metropolis* (1926) took the effects industry by storm. The Schüfftan Process artfully employed in *Metropolis* and other movies, utilized forced perspective techniques to create an illusion of size and distance. Such techniques are still common today, being used in such films as *Mighty Joe Young* and *Armageddon* (1998).

Willis O'Brien: The Lost World

Fritz Lang: Metropolis

Alongside this, MGM developed the Composite Reduction process allowing previously photographed footage to be inserted into specific areas of another frame, as in *The Hunchback of Notre Dame* (1923), *The Ten Commandments* (1923) and *Ben-Hur* (1926).

1930's and 1940's

The effects industry continued to grow through the 1930's with such films as *King Kong* (1933) and *Gone with the Wind* (1939). In 1934 Walt Disney's *Snow White* arrived ushering in a new era of full-length animated films.

Willis O'Brien: King Kong

1950's

The post-war years of the 1950's moved the focus of film to outer space, and with the development of the Motion Control Rig by Paramount, more sophisticated shots were developed. Meanwhile the SAGE Machine (Semi-Automatic Ground Environment) was created to follow enemy fighter planes during the Cold War. This provided the first interactive computer graphics. Some of the outstanding effects films of the 50's included *Destination Moon* (1950), *War of the Worlds* (1953) and *Forbidden Planet* (1956). The Blue Screen technique was also invented, enabling a person or object to be filmed against a blue, green, or sometimes red background, and then extracted and composited against a different background.

Semi-Automatic Ground Environment Machine

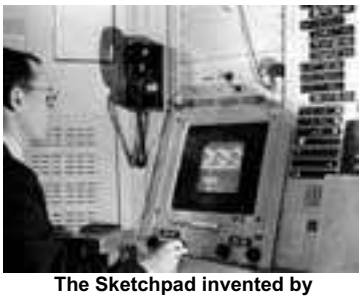
War of the Worlds

1960's

There was little technical development during the early 1960's. Ray Harryhausen's *Jason and the Argonauts* (1963) came out which included the famous Stop-Motion 'skeleton battle sequence' which is still inspiring filmmakers today (e.g. *The Mummy* (1999)). 1963 saw the first Academy Award given for Best Visual Effects, won by Hitchcock's *The Birds*. Then in 1968 Stanley Kubrick's *2001: A Space Odyssey* (Oscar winner), began to push the boundaries of special effects once again.

Ray Harryhausen: Jason and the Argonauts

Although the FX industry had not moved forward tremendously until the late 60's, the computer graphics industry had made headway. Ivan Sutherland had invented the Sketchpad interactive graphics software in 1962 and the University of Utah had opened the first CG department in 1966. 2D morphing techniques were first developed in 1967 at the University of Toronto, along with the development of Environmental Reflection Mapping (1976) and Bump Mapping (1978) by James Blinn. Triple-I created the first feature Film appearance of 3D CG, while in 1968 Ivan Sutherland and David Evans joined forces to open the world's first CG company, Evans & Sutherland, still going strong today. 1968 also saw the arrival of Ray Tracing developed by Bell Labs and Cornell University.



The Sketchpad invented by Ivan Sutherland

1970's

James Blinn

During the 1970's technology within computer graphics continued to grow, pushed forward by pioneers such as James Blinn and David Em. Bezier curves (1970) were invented along with both Gouraud (1971) and Phong (1975) shading. 1975 saw the development of a CG teapot that has now become the computer graphics icon. Ed Catmull went on to develop texture mapping in 1974, refined later in 1976 by James Blinn. Bill Gates founded Microsoft while Steve Woznick and Steve Jobs built the first Apple Computer. Also Quantel created Paintbox, the first graphics product aimed specifically at the broadcast industry.

George Lucas formed Industrial Light and Magic (ILM) to cover the huge array of special effects for his new film *Star Wars* (1977) (Oscar winner). Among those who joined were Dennis Muren, John Dykstra and Richard Edlund. A host of films began to appear utilizing CG, including *The Black Hole* (Oscar nominated) and *Alien* (1979) (Oscar winner). Also in that year Ed Catmull left NYIT and joined ILM to head up their CG department.

Industrial Light and Magic: Star Wars

1980's

Disney: Tron

In the 1980's, Triple-I continued their work producing seven minutes of CG for *Looker* (1980), while ILM produced the first all digital CG image for *Star Trek II: The Wrath of Khan* (1982), though Disney's *Tron* (1982) was the first extensive use of 3D CG. (For more information on Tron, click here.)

Where the Wild Things Are (1982-83) was a pioneering 35mm film test, which digitally composited 3D CG backgrounds with traditionally animated (digitally inked and painted) characters. The work was led by Chris Wedge (now vice-president of Blue Sky/VIFX, *Joe's Apartment*, *Star Trek: Insurrection* and *Bunny*). John Lasseter (director of *Toy Story*, *A Bug's Life*

and *Monsters Inc.*) left Disney and joined Lucasfilm Computer Graphics Division, working on the CG Endor moon sequence for "Return of the Jedi" (1983) (Oscar winner).
SGI (Silicon Graphics Inc.) was founded by Jim Clark in 1982 and by 1984 they had released their first product the IRIS 1000. The early 80's also saw a surge in the opening of graphics software houses and the release of new products onto the market. These included 1983: Alias Research Inc. (Alias/1), 1984: Wavefront (PreView), 1985: Softimage (Creative Environment) and 1982: Autodesk (AutoCAD).

Between 1980 and 1985 the special effects and computer graphics industries began not only to settle down but also to merge slightly. Richard Edlund left ILM in 1983 and formed Boss Film Corp., powering onto the market with effects work for *Ghost Busters* (Oscar nominated) and *2010* (1984) (Oscar nominated). Lucasfilm Computer Graphics Division released *The Adventures of Andre and Wally B* directed by John Lasseter. Disney's *The Black Cauldron* (1985) became the first animated feature film to contain a 3D element. Lucasfilm Computer Graphics Division produced the 3D animation required to bring to life a knight made of stained glass for the film *Young Sherlock Holmes* (1985) (Oscar nominated). The project was also the first to composite CG with a live-action background. Dennis Muren was the Visual Effects Supervisor.

Industrial Light and Magic: Young Sherlock Holmes

In 1986 Pixar was formed when the Lucasfilm Computer Graphics Division was purchased from George Lucas by Steven Jobs for $10 million. The pioneers included John Lasseter, Ed Catmull and Ralph Guggenheim. The company went on to produce the famous 'Renderman' software and animated features including *Luxo Jr.* (1986) (Oscar nominated), *Red's Dream* (1987), *Tin Toy* (1988) (Oscar winner), *Knick Knack* (1989), *Toy Story* (1995) (Oscar winner*), A Bug's Life* (1998), *Toy Story II* (1999), For The Birds (2000). (For more about Pixar and to view some of the short films depicted below, click here).

Howard the Duck (1986) was the first film to use digital wire removal and the first work carried out by the new ILM computer graphics department. Later that year they also worked on *Star Trek IV: The Voyage Home* (1986) which contained the first use of 3D scanning by Cyberware on a film. During the following year Arcca Animation produced *Captain Power and the Soldiers of the Future* (1987). It was the first TV series to include characters modeled in 3D entirely within the computer.

Industrial Light and Magic:
The Abyss

By the end of the 80's things were beginning to steam ahead. ILM won another Academy Award for *Who Framed Roger Rabbit*, and completed the first digital morph for *Willow* (1988) (Oscar nominated). The following year ILM produced 'the Donovan's destruction' sequence for the end of *Indiana Jones and the Last Crusade* (1989). The shot involved scanning multiple film elements into the computer, digitally compositing them together and then scanning back out to film. Also in that year, ILM produced the 'water pseudopod' creature for "The Abyss" (1989) (Oscar winner). The software used included Alias/2 and Photoshop. Dennis Muren, Mark A.Z. Dippe and John Knoll were some of the brains behind the success of the project.

1990's

As we move through the final decade towards the next millennium, the Computer Graphics and Special Effects Industries continue to break new boundaries and bring us the most spectacular array of visual imagery to date.

One of the newer CG companies to appear towards the end of the 80's was Rhythm & Hues. They produced over 30 shots of photorealistic airplanes, bombs and smoke all in daylight for a film *Flight of the Intruder* (1990). Another new company, deGraf/Wahrman, produced the first CG simulator ride that same year called *The Funtastic World of Hanna-Barbera*. They also produced the CG head of the robot villain for *Robocop 2* (1990). Disney produced the first completely digital film in the shape of *The Rescuers Down Under* (1990) and ILM painted the first digital Matte Painting for the film *Die Hard 2: Die Harder* (1990). The film also contained extensive Blue Screen Compositing for a sequence in which Bruce Willis is ejected out of a plane's cockpit. Pixar used their new Photorealistic Render software, Renderman, to produce the famous "Shutterbug" image. Autodesk released 3D Studio v1, their own 3D modeling and animation software.

Shutterbug Rendered at Pixar using Renderman Software

Industrial Light and Magic:
Terminator 2: Judgment Day

1991 marked the beginning of the ground breaking years. James Cameron's *Terminator 2: Judgment Day* (Oscar winner) brought to life by the artists at ILM began to change the way Hollywood perceived computer graphics. It was the first major digital character to be used in a film since the stained glass knight in *Young Sherlock Holmes*. Alias/2 and Photoshop were used along with a host of in-house tools designed especially for the project. Dennis Muren, Mark Dippe, Stefen Fangmeier, Tom Williams and Steve Williams were some of the people involved. Another major contribution that year came from Disney's *Beauty and the Beast*; the 'ballroom' sequence contained a complete 3D rendered background. Stop Motion was superceded by Go Motion created by Phil Tippet for *Dragonslayer* (1991).

During 1992 ILM continued to push the boundaries in *Death Becomes Her* (Oscar winner), creating photorealistic skin. Walt Disney also continued to push their techniques in both *Aladdin* and their short in-house project *Off His Rocker*. Also Virtual Reality hit Hollywood in the form of the *Lawnmower Man* (Angel Studios).

Industrial Light and Magic:
Jurassic Park

Various things happened the following year, but all were overshadowed by the release of Steven Spielberg's *Jurassic Park* (1993) (Oscar winner). ILM employed a huge range of tools to create CG dinosaurs and various other special effects needed for the film. These included Alias PowerAnimator, Softimage 3D, Matador and Lightwave (for simple animatics). 1993 also saw the rise of Digital Domain formed by James Cameron, Stan Winston and Scott Ross.

Dennis Muren, Steve Williams, Mark Dippe & Eric Armstong, ILM

1994 saw a significant rise in films containing CG. This included *Forest Gump* (ILM) (Oscar winner), *The Flintstones* (ILM), *The Mask* (ILM) (Oscar nominated), *The Lion King* (Disney), *Timecop* (VIFX), *The Shadow* (R/Greenberg Associates) and *True Lies* (Digital Domain) (Oscar nominated). Also Mainframe Entertainment's *Reboot* came out as the first 100% CG television show. Microsoft bought Softimage, and the computer game *Doom* was released.

During 1995 SGI acquired both Alias and Wavefront combining the two companies into Alias/Wavefront. In the film industry, *Toy Story* (Pixar) became the first full-length 3D animated film. *Judge Dredd* (Kleiser-Walzack Construction Company) became one of the first films to incorporate CG stunt doubles along with *Batman Forever* (Warner Bros.). ILM released *Jumanji*, further developing their ability to produce photorealistic hair, and *Casper*, the first CG characters to take a leading role. Rhythm and Hues' *Babe* won an Academy award for its special effects. Steven Spielberg, Jeffrey Katzenberg and David Geffen joined together to form Dreamworks SKG, and the Sony Playstation was released.

Digital Domain:
Apollo 13

Industrial Light and Magic:
Dragonheart

By 1996 *Dragonheart* (Oscar nominated) was finished. Rob Coleman of ILM oversaw hundreds of shots of the talking dragon, Draco, achieving not only a full range of emotional

Disney:
The Hunchback of Notre Dame

Rob Coleman, Animation Supervisor
Industrial Light and Magic

expressions but also the ability to talk. The breakthroug h ‘Caricature’ software or ‘Cari’ for short, had been developed by Cary Philips and has now become one of ILM’s main in-house tools. ILM also relied heavily on Alias/Wavefr ont’s Dynamation particle system software for the movie *Twister* (Oscar nominated). Disney’s remake of *The Hunchback of Notre Dame* used CG to produce crowds, props and other effects. Among the other big films to contain computer animation were *Space Jam* (Warner Bros.) combining

Volker Engel, Tricia Ashford & Doug Smith: Independence Day

traditional animation with live action, and *Independence Day* (Oscar winner). The computer game *Doom* was superceded by *Quake,* and Autodesk released 3D Studio MAX.

Digital Domain:
Titanic

Tippett Studios:
Starship Troopers

Digital Domain:
Dante's Peak

Alias/Wavefront's Dynamation particle system was again used in 1997 by ILM in the creation of a CG cape for *Spawn* together with realistic goo, drool and saliva. George Lucas restored Episodes 4, 5 and 6 of the *Star Wars* saga; over 350 shots were modified or added to the existing footage. James Cameron's company Digital Domain created a huge number of shots for *Titanic* (Oscar winner) which included extensive use of Motion Capture. Pixar won an Academy Award (in March 1999) for *Geri's Game (1998)* which utilized Subdivision surfaces. Radiosity Rendering was used in the creation of *Bunny (1998)* (Blue Sky/VIFX) which also won an Academy Award the same year. 1998 seemed to be a year of animation involving animals with *A Bugs Life* (Pixar) and *Antz* (PDI). Chris Landreth received a Genie Award for his contribution to *Bingo*, the test project used on the

Industrial Light and Magic:
Spawn

Industrial Light and Magic:
Jurassic Park: The Lost World

Digital Domain:
The Fifth Element

newly released Maya character animation and special effects package from Alias/Wavefront.

1999 has been an excellent year for both computer animation and special effects. In May George Lucas released the long awaited *Star Wars Episode 1: The Phantom Menace*, containing almost 2,000 digital effects created by Industrial Light & Magic under the supervision of Dennis Muren, John Knoll, Scott Squires and Rob Coleman. This was without question the biggest computer animation and special effects film in history. Among the digital tools used to create this ground breaking achievement were PowerAnimator, Maya, Softimage 3D, Commotion, FormZ, Electric Image, Photoshop, After Effects, Mojo, Matador, and RenderMan. Various proprietary in-house software packages were also used including Caricature, Isculpt, ViewPaint, Irender, Ishade, CompTime and Fred.

Industrial Light and Magic:
The Mummy

Tippett Studios:
The Haunting

Among ILM's other contributions this year are *The Mummy, The Haunting* and *Wild Wild West*. Other major effects movies this year include *The Matrix*, whose special effects were created by Manex Visual Effects, *Toy Story 2* (Pixar), *Supernova* (Digital Domain), *Deep Blue Sea* (Hammerhead) and *Lake Placid* (Digital Domain).

Industrial Light and Magic:
Star Wars Episode 1
The Phantom Menace

As we move into the next millennium, one of the big questions which is often asked within the computer animation and effects community is "what is the next big thing?" 'Jar Jar Binks' from *Star Wars Episode 1* (ILM) (1999) was the first photorealistic all digital main character in a feature film. People are still fascinated by the concept of entirely digital photorealistic humans. With the improvement in both hardware and software our ability to create more and better digital characters improves by the year.

Some people argue that various questions need to be asked before a huge amount of effort is put into one relatively small area of the industry. Elvis was Elvis not because of how he looked but because of how he moved and acted. There are hundreds of Elvis impersonators in the world, some of which are very good, but none of them are good enough to fool us into thinking Elvis has returned. The closer we get to creating a completely digital character the more our senses seem to alert us to the fact that something is not completely right and therefore we dismiss it as a cheap trick or imitation.

Mass.Illusion:
What Dreams May Come

There are no doubt many reasons for using digital humans, such as for stunt stand-ins or simply for those impossible situations conjured up by Hollywood, but as Dennis Muren of ILM once said, "Why bother! Why not focus on what doesn't exist as opposed to recreating something that is readily available." Over the last few years we have begun to see animation and special effects creating more impossible situations such as the 'Flow-Mo' and 'Bullet Time' effects shots of *The Matrix* (1999) and the beautiful artistic style of *What Dreams May Come* (1998).

Manex Entertainment:
The Matrix

Hollywood has found there to be a huge shortage of dinosaurs, dragons, Gungans and various other creatures and characters needed for lead roles in today's motion pictures. A lot of people are very keen to see the progression of digital creatures taken to its logical conclusion of human beings, while others say the focus should be on more artistic effects. Whatever your opinion is, you can be sure of one thing: the magic of computer animation and special effects will continue to advance even faster into the next millennium as a tool to bring to life the dreams of storytellers.