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**The Computer Graphics**

**HISTORY OF COMPUTER GRAPHICS**

**WHAT IS COMPUTER GRAPHICS……………**

Computer graphics means drawing pictures on a computer screen. What's so good about that? Sketch something on [paper](https://www.explainthatstuff.com/papermaking.html)—a man or a house—and what you have is a piece of analog information: the thing you draw is a likeness or analogy of something in the real world. Depending on the materials you use, changing what you draw can be easy or hard: you can erase pencil or charcoal marks easily enough, and you can scrape off oil [paints](https://www.explainthatstuff.com/howpaintworks.html) and redo them with no trouble; but altering watercolors or permanent markers is an awful lot more tricky. That's the wonder of art, of course—it captures the fresh dash of creativity—and that's exactly what we love about it. But where everyday graphics is concerned, the immediacy of art is also a huge drawback. As every sketching child knows too well, if you draw the first part of your picture too big, you'll struggle to squeeze everything else on the page.... and what if you change your mind about where to put something or you want to swap red for orange or green for blue? Ever had one of those days where you rip up sheet after sheet of spoiled paper and toss it in the trash?

That's why many artists, designers, and architects have fallen in love with computer graphics. Draw a picture on a computer screen and what you have is a piece of digital information. It probably looks similar to what you'd have drawn on paper—the ghostly idea that was hovering in your mind's eye to begin with—but inside the computer your picture is stored as a series of numbers. Change the numbers and you can change the picture, in the blink of an eye or even quicker. It's easy to shift your picture around the screen, scale it up or down, rotate it, swap the colors, and transform it in all kinds of other ways. Once it's finished, you can save it, incorporate it into a text document, print it out, upload it to a [web](https://www.explainthatstuff.com/howthewebworks.html) page, or email it to a client or work colleague—all because it's digital information. (Find out more about the benefits of digital in our main article about [analog and digital](https://www.explainthatstuff.com/analog-and-digital.html).)

Computer Graphics (CG) was first created as a

visualization tool for scientists and engineers in government

and corporate research centers such as Bell Labs and Boeing

in the 1950s. Later the tools would be developed at

Universities in the 60s and 70s at places such as Ohio State

University, MIT, University of Utah, Cornell, North Carolina

and the New York Institute of Technology.

The early breakthroughs that took place in academic

centers continued at research centers such as the famous

Xerox PARC in the 1970¹s. These efforts broke first into

broadcast video graphics and then major motion pictures in

the late 70¹s and early 1980¹s. Computer graphic research

continues today around the world, now joined by the research

and development departments of entertainment and production

companies. Companies such as George Lucas¹s Industrial

Light and Magic are constantly redefining the cutting edge

of computer graphic technology in order to present the world

with a new synthetic digital reality.

1940s

The very first ³computer assisted² graphics began in

many different unrelated fields around the world. There is a

very blurred line that is crossed somewhere between

mechanical and analog computer assisted graphics, and the

first directly digital computer generated graphics that would

associate with today as being true ³CG².

The very first radiosity image.

While at MIT in the 1940s, Professors Parry Moon and

Domina Eberle Spencer were using their field of applied

mathematics to calculate highly accurate global lighting

models which they called ³interflection reflection². The

illumination algorithms were based on those by H. H. Higbie,

published in his 1934 book, Lighting Calculations.

Lacking any display or output mechanism, the image

itself was created by painstakingly selecting Munsel paper

samples that matched the output data of their mathematical

model. The paper was cut out and ironed together by hand to

create the image shown here in print for the first time in

over 50 years.

[IMAGE OF THE RADIOSITY PIC]

(The original image is still hanging in the office of

Dr. Domina Spencer at the University of Connecticut.)

The images were first presented at the 1946 National

Technical Conference of the Illuminating Engineering Society

of North America, and published two years later (in color) in

the book: Lighting Design by Moon, P., and D. E. Spencer.

1948. (Addison-Wesley. Cambridge, MA) The book was used for

many years to teach lighting theory at MIT in the

architecture curriculum there. Dr. Spencer went on to teach

at Tufts, Brown, Rhode Island School of Design, and the

University of Connecticut where she remains active today.

1950s

€John Whitney Sr. devises his own computer assisted

mechanisms to create some of his graphic artwork and short

films. One of his sons John Jr. works with and learns from

his father from childhood through high school.­see biography

€Pioneering artists Stan VanderBeck, Michael Noll and

others at Bell Labs in New Jersey created computer assisted

graphics using analog computer devices and plotter output.

Later, in the mid 1960s, digital computers and film recorders

would be used to produce some of the earliest CG animated

films

€Bill Fetter experimented with early vector graphic CAD

at Boeing (Seattle) in the late l950s using an IBM 7094

computer with punch card input and a Gerber plotter.

1950

Artist Ben Laposky uses analog computers to help him create

oscilloscope artwork.

1951

Vectorscope-type graphics display on the Whirlwind computer

at MIT. A device similar to a light pen allowed direct input to the screen.

The General Motors Research Laboratory begins to study

the role of computer aided graphical design applications.

(This would later result in the development of the DAC-1)

1955

SAGE system at MITs Lincoln Lab uses the first true light pen

as input device. (Bert Sutherland)

1956

Lawrence Livermore National Labs connects graphics

display to IBM 704; use film recorder for color images

Bertram Herzog at the University of Michigan Computing

Center uses analog computers to generate CRT graphic studies of military vehicle behavior.

1957

1st image-processed photo at National Bureau of Standards.

(By whom? Why?)

The IBM 740-780 (paired with a separate IBM 704 computer

system) generated a sequence of points on a CRT in order to

represent lines or shapes. Time lapse film photography was

used to capture the images as they were drawn on the screen.

The Defence Departments Advanced Research Project Agency

(ARPA) is founded.

1958

MIT¹s Lincoln Labs: Funded in part by the Air Force;

Steven Coons, Ivan Sutherland, and Timothy Johnson begin

working with the TX-2 computer system to manipulate drawn

pictures. Ivan Sutherland later began refining the work into

his famous Sketchpad system while a student at MIT. DEC

later commercialized the TX-2 as the PDP-6.

1959

The first commercial film recorder ­ the General Dynamics

Stromberg Carlson 4020. (Produced in San Diego, CA.)

1959

DAC-1 (Design Augmented by Computers): First computer aided

drawing system. Created by Don Hart and Ed Jacks at General

Motors Research Laboratory and IBM. (Not unveiled until

the Fall Joint Computer Conference in Detroit in 1964.) The

system was originally based upon a IBM 7090 computer (later

upgraded to a 7094 in 1963) augmented with extra disc space

and a specially designed IBM 7969 ³image processing system².

Input was with punch cards, but was also capable of scanning

in drawings. The final data could be output to either 35mm

film (by way of a CRT), a hard copy plotter, or used to drive

computer controlled machining devices.

Biography: John Whitney Sr. (1917-1995)

A Los Angeles native, Whitney was a pioneer in many

forms of experimental and abstract art before turning to

computers to aid in his graphic creations. He attended Pomona

College in California in the 1940's and was the first in a

wave of artists to begin new techniques of computer

assisted graphics.

The integration of analog computer controlled camera and

artwork were at first more a pioneering use of motion control

than of computer graphics. In point of fact, the devices

these early artists used were not even thought of as

computers, being more akin to analog music synthesizers. From

his experience working in the aircraft industry during World

War II, Whitney realized that components of a computerized

anti-aircraft controller could be used to drive his

mechanisms. One of his sons (John Jr.), recalled buying the

³state-of-the-art² M7 anti-aircraft control computer at

surplus. The still unopened crate was 12 feet long, 7 feet

wide and seven feet tall. These synchronized mechanisms would

ultimately be used to calculate abstract shapes, and change

them over time to create beautifully abstract forms and

animation.

In the 1950¹s Whitney worked in Hollywood as an

animation director at UPA, most notably contributing graphic

elements for the Saul Bass designed opening credits to

Hitchcock¹s ³Vertigo². Whitney then founded Motion Graphics

Inc. in 1960 and produced animation for both television and

film, devising the ³slit scan² technique for his early short

film ³Lapis². This technique would later be made famous when

used by Con Pederson as a portion of the famous ³StarGate²

ending sequence of Stanley Kubrick¹s ³2001: A Space Odyssey².

In 1966 with the help of a grant from IBM and a Fortran

programmer named Jack Citron(sp?), Whitney made his first

digital computer short film called "Permutations". His next

works: Matrix 1 and Matrix 2 were done at Cal Tech,

followed by Matrix 3 at Triple-I in 1971. It was at this

time that he met Larry Cuba who would later be asked by

Whitney to collaborate with him in 1975 on his last 16mm film

project ³Arabesque², funded in part by an NEA grant. Both

Whitney and Cuba would work briefly at Robert Abel¹s effects

company before digital computer graphics were begun there.

Beginning in the mid 1980's, a new collaborator Jerry

Reed(sp?) translated Cuba¹s Fortran code into Pascal for use

on new personal computer hardware that Whitney could use at

home. Whitney continued to create abstract computer animation

on his own with the aid of this new PC technology that freed

him from the reliance of large company owned mainframe

machines and the need for sponsored grants. His work would be

displayed in galleries on the same PC hardware he created it

on. His last commercially available collection of works,

called ³Moondrum² was released on video in the late 1980¹s.

Today his son Michael Whitney is serving as archiver for his

fathers work, and recently organized a retrospective showing

at UCLA.

1960's

€³Computer assisted graphics² were being created more

widely as a new and unique art-form by people such as Charles

Csuri, Ken Knowlton and John Whitley Sr.

€Many pioneering artistic films and artworks were

created at Bell Labs from about 1962 to 1967 by artists and

programmers such as E.E.Zajac, Leon D. Harmon, Ken Knowlton,

A.Michael Noll, Lilian Shwartz, M.R. Schroeder and Stan

Vanderbeek. An IBM 7094 computer ran a Stromberg-Calson 4020

film recorder, programmed in FORTRAN to run Ken Knowltons

Beflix animation system.

Much of the nation-wide university computer science

research conducted at the time was due in part to funding

from the government¹s "Advanced Research Project Agency"

(ARPA). ARPA at the time took a very hands-off approach to

funding. This allowed researchers an un-pressured environment

in which to concentrate on the work, without the heavy

bureaucracy, paperwork and political constraints more common

today. Much to the benefit of researches was Ivan Sutherland

who headed ARPA for a time. With good funding, little

oversight and many brilliant young minds inspiring each

other, it was a unique and special time that produced the

very foundation of today¹s computer graphic tool sets.

€Herb Freeman had a school of CG development going on

at NYU including Alvy Ray Smith in his first professor's job

out of Stanford in 1969. Freeman and his students had already

solved the hidden-line problem, a very big deal at the time.

[Quote] ³Also on the pixel side of things, Azriel

Rosenfeld at the Univ of MD, and Ron Baecker was developing

some of the very first computer animation. I saw his system

GENESYS at an NYU demo in the early 1970s which means Ron

probably did the development (in Canada, Toronto, I think) in

the late 1960s.² -Alvy Ray Smith

€Nicholas Negroponte teaches Computer Aided Design

(CAD) at M.I.T in the mid to late 60s, and develops the

URBAN5 system. A light pen allows interaction directly on the

CRT, in combination with keyboard instructions. Points and

symbols are added in orthographic mode with a perspective

option entered after the fact in order to view structures

three-dimensionally. An ³intelligent² system study, URBAN5

was abandoned by 1968 in favor of other projects.

€³The Society for Information Displays² is formed

in the early 60s, publishing papers dealing mostly with

military applications.

€At this same time, practical commercial and industrial

use of computer graphics begins to take hold in many areas of

design and manufacturing. Throughout the decade at Boeing,

William Fetter and Robert Woodruff (Computing Technology

Administrator) leads many important industrial applications

of vector generated CG.

€Architectural and urban planning programs (typically

written in FORTRAN on machines like the IBM 1130 or 1800) are

used at the firm ³Skidmore, Owings & Merrill² in Chicago and

in the University of Texas School of Architecture. A sample

workstation would consist of a Rand tablet providing input,

with output to pen plotters such as the Calcomp.

€In the late 60s, the Electronics Laboratory of

General Electric (Syracuse, NY) produces a prototype

visualization system for NASA and the Office of Naval

Research. The system produced real-time color raster graphics

on a monitor as a training aid to astronauts going to land on

the moon. This same system was used by Prof. Peter Kamnitzer

of the UCLA School of Architecture and Urban Planning to

simulate urban development plans.

Biography: Dr. Dave C. Evans (1924-1998) MORE

One of a very few who could be called a true "founding

father" of computer graphics, Dave Evans is perhaps best know

for being the co-founder of "Evans & Sutherland Computer

Corporation". Mr. Evans was at one time chairman of the

computer science departments at both the University of

California Berkeley and University of Utah, where he started

the venerable doctoral program that would give birth to so

much of the foundation of our industry. Evans first

associated with Ivan Sutherland at both Berkeley and the

Pentagon's "Advanced Research Project Agency" (ARPA).

Mr. Evans made many contributions to a wide range of

computer technologies, and a great many of his students went

on to flourish in the brand new field of computer graphics,

becoming true pioneers themselves. Students of Mr. Evans

include Alan Kay(Co-founder of Xerox PARC), Jim Clark

(founder of both Silicon Graphics and Co-founder of Netscape

Communications), John Warnock(Co-founder of Adobe Systems)

and Edwin Catmull(see biography in Programming chapter).

Dave Evans passed away on Oct.3rd, 1998.

1960

William Fetter of Boeing coins the term "computer

graphics" for his human factors cockpit drawings. With help

from Walter Bernhardt, and others, Fetter input an aircraft

drawing¹s coordinates into a database and plotted out a

calculated perspective on a ³Illustromat 1100² plotter.

John Whitney Sr. founds Motion Graphics, Inc. in LA.

1961/62

Spacewar: The first popular computer graphic game

written by students Steve Russell, Slug Russell, Shag Graetz,

and Alan Kotok of MIT to run on the DEC PDP-1. (DEC's PDP-1

cost $120,000 and MIT¹s was one of only 50 ever built) The

large round CRT display featured graphics controlled by

primitive handmade joysticks. The object being to maneuver

away from a gravitational ³sun² force at the center, and

avoid the other enemy ships, while trying to blast him with

your own space torpedoes!

The original source code (which ran on 4k of memory!)

can still be found at

www.media.mit.edu/groups/el/projects/spacewar/sources

or ftp://ftp.digital.com/pub/DEC/sim/sources/sim\_2.3d.tar.Z

There's also a copy of the PDP-1 manual at

www.dbit.com/~greeng3/pdp1/pdp1.html

1962

"Sketchpad: A Man-Machine Graphical Communication

System" is presented by Ivan Sutherland as his Ph.D. thesis

at the M.I.T. Lincoln Laboratory. The user could input simple

lines and curves by drawing directly on the screen with a

light pen. The computer, the TX-2, had a whopping 320

kilobytes of memory and a 9 inch monochromatic CRT.

While Sketchpad was strictly 2D, a few years later

Timothy Johnson expanded its capabilities into three

dimensions as ³Sketchpad 3². The display CRT was divided up

into the now familiar four views, top front side and

perspective.

ARPA J.C.R. Licklider is put in charge of the new Information

Processing Techniques Office (IPTO) at the Defense

Departments Advanced Research Project Agency (APRA).

The initial $14 million dollar budget supported projects at

MIT, Berkeley and Carnegie-Mellon.

1963

Biography: Ivan Sutherland

Born in 1938, Hastings, Nebraska; Ivan Sutherland is truly an

early ³founding father² of computer graphics. After

completing his Ph.D. at M.I.T.(where he developed Sketchpad)

in 1963, Ivan Sutherland joined the army and was assigned to

the NSA as an electrical engineer. One year later, he was

transferred to the Defense Department's Advanced Research

Projects Agency (ARPA, later DARPA), and given responsibility

for the newly-established Information Processing Techniques

office. At age 26, Lt. Sutherland was given a secretary and

$15 million a year, and was told to "go sponsor computer

research." Which he gladly did for the following two years

until joining the faculty at Harvard late in 1966. It was

here with student Bob Sproull that they developed the Head

Mounted Display (HUD), for remote viewing; the first

³Virtual Reality².

In 1968 Ivan formed the Evans & Sutherland company

with partner Dave Evans. Ivan was now a part time tenured

professor at the University of Utah, where Evans was the

founding head of the Computer Science Department. Dr.

Sutherland had first met Evans during a visit to U.C.

Berkeley as part of his ARPA work.

Ivan's last research in computer graphics was a paper

titled: "A Characterization of Ten Hidden-Surface

Algorithms," by Sutherland, Sproull and Schumacker. The paper

solved many of the largest problems of the day in this

critical area of rendering and display technology.

Later, as co-founder (with Carver Mead) and head of the

Department of Computer Science at California Institute of

Technology from 1976 - 1980, Dr. Sutherland developed and

promoted courses involving integrated circuit design, the

seed of knowledge that helped create the Silicon Valley

industry.

In the early 1980s at Carnegie Mellon University, Ivan

did some research on a six legged walking robot, large enough

to carry a driver. (And controlled by a joy stick acquired by

brother Bert from his contacts in the Navy as a former

fighter pilot!)

In 1980, Ivan and Bob Sproull had started the consulting

firm ³Sutherland, Sproull & Associates². Sun bought the

company in 1990, which then became the nucleus of Sun

Microsystems Laboratories.

Today?

Charles Csuri created an analogue computer and used it to

make transformations of a drawing. He completed a series of

drawings based upon the paintings of old masters such as

Durer, Goya, Ingres, Klee, Mondrian and Picasso

Ken Knowlton's programs BEFLIX and EXPLOR are used to create

early computer films at Bell Telephone Labs.

The 1st computer art competition, sponsored by Computers

and Automation magazine.

The Spring Joint Computer Conference has several people from

MIT presenting papers on graphical display technology: Steven

Coons, Ivan Sutherland, Tim Johnson, Bob Stotz, Doug Ross and

Jorge Rodriquez.

John Lansdown pioneered the use of computers as an aid to

architectural planning, making perspective drawings on an

Elliott 803 computer in 1963, modelling a building's lifts

and services, plotting the annual fall of daylight across its

site and authoring his own Computer Aided Design

applications.

Edgar Horwood developed a computer graphic mapping system

used by the U.S. Housing and Urban Development. HUD publishes

³Using Computer Graphics in Community Renewal²

Frieder Nake at The Computer Institute of the Stuttgart

Polytechnic uses the Graphomat Zuse Z 64 Drawing machine to

produce 4 color plotter drawings.

1964

[QUOTE] ³I did my first computer graphic at the Physical

Sciences Lab at New Mexico State University. I was asked

to generate an equiangular spiral antenna for one of the

early Nimbus weather satellites. The old engineers asked me,

a student, to do the tedious hand-drawing. I got a computer

to draw the spiral quickly, amazing the old-timers.² ­Alvy

Ray Smith

Ivan Sutherland (a recent MIT gradute) takes over at the

Information Processing Techniques Office (IPTO) at ARPA. It

is suggested by his predisesor J.C.R. Licklider to take on a

'deputy', Bob Taylor. (The office¹s budget would reach $30

million by 1969, when it was changed to DARPA the Defense.)

Sutherland transitions out of his office by early 1966 to go

to Harvard, leaving Bob Taylor in charge. (Bob Taylor would

later go on to play a key role in staffing the famous Xerox

PARC.)

1965

Dr. David Evans founds the Computer Science Department at the

University of Utah

Ohio State University CG program started by Charles Csuri.

1st computer art exhibition, at Technische Hochschule in

Stuttgart

Bella Julesz and A.Michael Noll exhibit for the 1st U.S.

computer art exhibition, at Howard Wise Gallery in New

York (April, 1965)

196?

First commercially available graphics computer: IBM 2250

(When was the DEC 338??)

[FACTOID COSTS] A typical graphic display CRT cost about

$40,000 US. Rand input tablets are about $10,000 US, and

Calcomp plotters about $4000 US.

1966

"Odyssey": The first consumer computer graphics games

product by Ralph Baer of Sanders Associates. Later marketed

at Magnavox.

Permutations: With a grant from IBM and a Fortran programmer

named Jack Citron(sp?), John Whitney Sr. made the first

digital computer short film. An IBM 2250 Graphic Display

Console created dot patterns which were then recorded onto

black and white 35mm film. The filmed images were then

further enhanced with a specially designed optical printer to

add secondary motion and color.

As Associate Professor at Harvard, Ivan Sutherland and his

students, Bob Sproull, Jim Clark and others, took earlier

"Remote Reality" vision systems of the Bell Helicopter

project, and turned it into what we now call Virtual

Reality by replacing the camera with computer images. The

first such computer environment was no more than a wire-frame

room with the cardinal directions -- North, South, East, and

West initialed on the walls. The viewer could "enter" the

room by way of the West door, and turn to look out windows in

the other three directions.

Affectionately called ³The Sword of Damocles² because of

its ceiling mounted gear, what they called the "Head-

Mounted Display," later became known as Virtual Reality.

The International Conference on Design and Planning:

³Computers in Design and Communication² is held at the

University of Waterloo (Ontario). Organized by Professors

Constant and Krampen of the Design Department, it was brought

together to enlighten and inform designers of emerging

computer technologies.

1967

[QUOTE] ³At the same time that geometry-based computer

graphics (CG) was being invented so was sampling theory-based

computer graphics, often called image processing (IP) or

imaging. In the early days, two conferences - one for each

half of the discipline - would be held side by side. One of

the earliest journals was called Journal of Computer

Graphics and Image Processing. Its editors were Herb

Freeman and Azriel Rosenfeld (CG and IP, respectively). The

earliest paper that I actually have in possession on IP side

is ³Processing of Tiros Cloud Cover Pictures on a Digital

Computer² by Albert Arking, 1967, but I'm sure the literature

is much older. It's easy for the geometry based guys to leave

all this stuff out and vice versa.² ­Alvy Ray Smith

Allen Bernholtz and William Warntz of the Laboratory for

Computer Graphics and Spacial Analysis at Harvard

University use computer graphics to study layout and sound

patters for hospital floorplans.

Cornell University's School of Architecture is founded by

Professor Donald Greenberg.

Charles Csuri creates his famous ³Hummingbird² film. A

ten minute long, vector interpolated 16mm film animation that

is later purchased by the Museum of Modern Art as part of

their permanent collection.

2D morphing techniques used were started by Les Mezei at the

University of Toronto

The MIT Center for Advanced Visual Studies is founded by

Gyorgy Kepes

The Computer Technique Group in Tokyo Japan is funded at

the IBM Scientific Data Center. Engineers and designers

create many beautiful and varied computer graphic art works,

using image processing and geometric transformations. Members

include Koji Fujino, Junichiro Kakizaki, Masao Komura, Fujio

Niwa, Makoto Ohtake, Haruki Tsuchiya, and Kunio Yamanaka.

Stephen Coons is Associate Professor of Mechanical

Engineering at M.I.T., where he heads the computer aided

design (CAD) group. He invents a method for patch continuity

1968

Robert Mallary, Professor at the Department of Art at the

University of Massachusetts developed the TRAN2 computer

program for calculating three-dimensional sculpture

Cybernetic Serendipity: The Computer and the Arts

exhibition at London Institute of Contemporary Arts (ICA) is

organized by Jasia Reichardt. The first major public computer

art show, Cybernetic Serendipity is also a book published

at the same name.

The UK's Computer Arts Society (CAS) is founded by John

Lansdown at the Royal College of Art.

The EVENT ONE computer art exhibition is held at the Royal

College of Art. Chaired and organized by John Lansdown.

CalComp (California Computer Products) holds a competition

for the best ³Computer Plotter Art², with scholarship and

cash prizes.

The first computer animation in the UK was the FLEXIPEDE

made by Tony Pritchett. Made at the Open University.

Several computer art publications are available in Europe

including Bit International out of Zagreb, and Page by the

London Art Society, a monthly magazine which actually lasted

until the mid 80s.

Ivan Sutherland joins the Computer Science Department at

University of Utah

The very first computer graphics company was formed by two of

the leading researchers of the day, Drs. David C. Evans and

Ivan E. Sutherland. Aptly named Evans & Sutherland, it

provided a vector system comprised of custom designed

hardware and software previously available only to one of a

kind, multi million dollar military sites.

Dicomed is founded as a manufacturer of hardware and

software products to apply computer graphic technology to the

field of medical radiology. Their systems operate by scanning

x-ray films, converting the information into digital data,

enhancing it and redisplaying the processed image. (See their

web site at www.dicomed.com ). Still in business 30 years

later, providing professional high resolution digital image

capturing technologies.

Bill Fetter contributed to the first (vector based)

computer generated television commercial in 1968 while

at Boeing.

1969

[IMAGE RAM 2/9 plotted drawing 1969]

Edward Zajec begins a long career of fine art aided by the

computer, creating plotter output works using an IBM 60/20 at

Carlton Collage in Minnisota. He would later spend 10 years

as an Artis-In-Residence at the University of Triese in

Italy. He returned to the united states to Syracuse

University in 1980 to reinvigorate the CG program there which

had begun in the early 70s. http://web.syr.edu/~ezajec/ez-

plain.html

[IMAGE RAM 3/16 plotted drawing 1969]

[COINCIDENCE!] It should be noted that this Edward Zajec

(with an ³e²) is not the same as the Edward Zajac (with an

³a²) who worked at Bell Labs. Two early pioneering CG

artists, two very closely spelled names!

LDS-1 (Line Drawing System). The first commercial CAD

wireframe graphics machine system released by E&S.

Incorporated hardware design from Garry Watkins, designed

input by Chuck Seitz (University of Utah faculty 1970-73),

Bob Shumaker and others.

[LDS-1 FACTOID] A local play-on-words for the LDS-1 was

based on the fact that the Mormon church was very prominent

in Utah, and more commonly known by the contraction of the

Church¹s full name ³Latter Day Saints²: LDS

John Warnok (University of Utah Ph.D. 1969) Developed the

Warnock recursive subdivision algorithm for hidden surface

elimination.

Alan Kay (University of Utah Ph.D. 1969 ) First developed the

notion of a graphical user interface with the Alto project at

Xerox PARC (Palo Alto, CA), which directly influenced the

design of Apple MacIntosh computers.

Computer artist Lloyd Sumner creates Christmas cards under

the company name ³Computer Creations²

Bell Labs developed the first frame buffer for storing and

displaying 3bit images.

Gary Demos first becomes acquainted with computer assisted

graphics with John Whitney Sr. who is teaching at Cal Tech

in California. An IBM 2250 ran a custom operating system,

images where photographed in Ektachrome and printed on

Kodachrome.

1970's

Widespread commercial use of this early technology did

not begin until the 1970¹s when early pioneers saw the

potential in the broadcast video market for the new creative

tools. Companies like Image West(LA), Dolphin Productions

(New York) and Computer Image Corp (Denver, President Lee

Harrison) used these realtime computer assisted video

graphics machines to introduce new imagery to both broadcast

clients and the viewers at home.

[BIO SNIP] Lee Harrison, the inventor of analog video-

based computer animation, was the founder of Computer Image

Corporation(1969) in Denver, CO.; where the ANIMAC,

Scanimate, C.A.E.S.A.R., and System IV analog animation

devices were developed. Lee won an Emmy for SCANIMATE in

1972.

Relatively affordable commercial random access frame

buffers became available in the mid to late 70¹s which opened

up the market for CG production. The input for these earliest

machines were often banks of patch wires, paper tape or punch

cards, very different from today's mouse and graphic

interfaces.

These first million dollar commercial machines were

mostly capable of only limited, video resolution raster based

graphics. While their output was limited in most cases to

videotaping or filming monitor screens, their imagery did

introduce the public at large to the new art form. By the end

of the decade affordable raster technology out paced the

earlier vector graphic mainstay.

€Pioneering work done by Jim Blinn at the Jet

Propulsion Laboratory (JPL) in Pasadena California

(started in 1975 by Bob Holzman). David Em (who would work

with Alvy Ray Smith at Xerox PARC on Dick Shoup's Superpaint

system in about 1974 or so) also later joined Jim at JPL to

create some of the early serious computer art in raster form.

€Nelson Max at Lawrence Livermore National

Laboratories uses CG to illustrate basic biologic research;

the first ³scientific visualizations².

€Jim Kajiya, Gary Demos, Steve Gabriel and the Cal Tech

contingentŠ

[FACTOID] Artist and Author Jasia Reichardt estimates

in 1970 that there are perhaps ³1000 people in the world

working with computer graphics² who are not involved in pure

research or mechanical design. (In other words: CG artists)

1971

Gary Demos visits NASA AMES and Evans & Sutherland while

researching a documentary film about computers for ³Dimension

Films² in LA. It is there that he first meets Ivan Sutherland

and expresses his ambitious desire to create complex and

realistic high resolution CG images for films. (Gary is only

about 21 years old at the time) Since most of the hardware

and software technology that would make this possible does

not yet exists, Gary joins E&S in hopes of creating these

missing pieces. John Warnock ran the San Jose E&S office

before going to NYIT, and Ivan himself was working on his own

hidden surface solutions at the time. Gary helped develop a

high precision ³data table² (table not tablet because it was

4 feet by 5 feet) accurate to 100th of an inch for digitizing

images. The table used two pens to define two simultaneous

points in 3D space. Programming was done in assembly code on

a PDP-11 with a Picture System 1 for vector display.

Both Henry Gouroug and Bui Toi Phong worked on shading

at E&S, so that area was well covered needless to say. Gary

and the E&S team next tackled the challenge of building the

first ever random access frame buffer. They began with the

first 8 DRAM chips every produced, which came from a company

in Texas called Mostek(sp?).

1972

PONG developed by Nolan Bushnell. (Later founder of Atari)

The first feature film appearance of CG: West World. A

"block pix" scene done at Information International Inc.

(III; aka "Triple I") Led by John Whitney Jr., digitally

processed film was used to portray a pixelated android point

of view.

1973

ACM/SIGGRAPH is formed

'Interact' at the Edinburgh Festival, a seminal event in

establishing the use of computers for the creation of art

works. Organized by John Lansdown.

Edwin Catmull (Ph.D. 1974 University of Utah) develops both

the Z-buffer algorithm and the concept of texture mapping

in 1973-74. (Texture mapping techniques were later refined by

Catmull, Alvy Ray Smith, Tom Duff, Lance Williams, and Paul

Heckbert at NYIT.

First physical structure designed entirely with computer-

aided geometric modeling software: A large Easter egg which

is still standing in Vegreville, Alberta, Canada. "The Easter

Egg Capitol of the World". By Ronald Resch, pioneer in the

field of computer art, and member of the Computer Science

Faculty at University of Utah from 1970-1979. The programmer

that worked with Resch was Robert McDermott (who got his

Ph.D. from the work at U. of Utah).

Frank Crow (University of Utah Ph.D. 1975) Developed anti-

aliasing methods for edge smoothing.

1974

The first ACM/SIGGRAPH conference is held in Boulder

Colorado. There are 600 attendees.

The New York Institute of Technology Computer Graphics

Laboratory (CGL) is founded in 1974 Dr. Alexander Schure,

and hires recent Utah graduate Edwin Catmull to head the new

CGL group. (See the companies chapter for a good history of

the NYIT CGL.)

Phong Bui-Toung develops the Phong shading method at Utah.

(Later become a professor at Stanford? When?)

Dr. Ivan Sutherland and associate Glen Flex start a Hollywood

company called Picture Design Group with John Whitney Jr.

and Gary Demos. One of the first tests they do is for a

feature film proposed by Walter Films and Carl Sagan, called

³Cosmos². Using an E&S Picture System at UC San Diego Demos

began tests on one-million-star galaxy simulations. Operating

with a clunky front-end system that crashed every fifteen

minutes, it forced him to wait 5 minutes to boot, and took 5

minutes to back up data after only 5 minutes of working

before the system would crash again. (in addition to having

to go so far as to write his own random number generator)

They did other work for educational films, and the

Museum of Science and Industry, but after about 9 months Ivan

wanted to give in favor of going back to academia. Demos and

Whitney would then go to Triple-I.

1975

ACM/SIGGRAPH in Bowling Green, Ohio with 300 attendees.

Hunger by Peter Foldes: "First fully animated figurative

film every made using computer techniques.² (Computer

Interpolation or inbetweening). Like Csuri¹s work, some of

the first geometric interpolation or "Morphing" techniques.

Foldes would also create the film "Metadata"

The venerable icon of early computer graphics, the famous

³Utah Teapot² is designed by Martin Newell at the University

of Utah.

The TWEEN animation system is developed by Dr. Edwin Catmull

at NYIT. Originally written in assembler language (Ed hated

Fortran), TWEEN was re-written completely in C to run on UNIX

about a year later (It took up ??megs of memory on a PDP-11).

He then actually renamed the program ³MO-TRUCK² for ³motion

trucking-thru-the-frames² but no one would use the new

nameŠso TWEEN it stayed.

After 20 years of research Dr. Benoit Mandelbrot publishes

his seminal paper: "A Theory of Fractal Sets." The study of

fractal geometry is revealed to the popular press. (The

theory had been around before, and contributed to by

noteworthy mathematicians such as Julia, Poincare, and

Falconer. Mandelbrot gave it a name and codified it.)

John Whitney Jr. and Gary Demos form the Motion Picture

Project Group at Triple-I.

1976

ACM/SIGGRAPH in Philadelphia, Pennsylvania with 300

attendees, and the first exhibition (with 10 exhibitors!)

Future World: Gary Demos, John Whitey Jr. and a team at

Triple-I creates the first feature film appearance of 3D CG;

a 3D polygonal representation of a hand, and of actor Peter

Fonda¹s head. (Rendered and filmed out at 2000x2560 pixel

resolution.) The film also featured the first ever digital

composite, a sequence of ³samurai warriors² materializing in

a chamber room.

Warner Communications buys Atari from Nolan Bushnell for $28

million

Nelson Max's sphere inversion film shown at SIGGRAPH

Jim Blinn environment (reflection) mapping while a graduate

student at the University of Utah. The paper is co-authored

with his professor Martin Newell, published in the

Communications of the ACM in 1976.

[SIDEBAR] Close Encounters CGŠALMOST!

Bo Gehring, founder of Bo Gehring Associates of Venice,

California, produced computer animation tests for Steven

Spielberg's CLOSE ENCOUNTERS OF THE THIRD KIND. Like similar

tests created by Triple-I, the tests did not result in any CG

production work on the film.

1977

ACM/SIGGRAPH in San Jose, California with 750 attendees and

38 exhibitors.

Star Wars (Twentieth Century Fox)

The Death Star simulation was designed and created by

pioneering algorithmic artist Larry Cuba. George Lucas was

impressed both by Cuba¹s early abstract CG film First

Fig(1974) and the fact that he had worked with another

pioneer of motion control and computer graphics John Whitney

Sr. Ben Burt, the films sound designer, had been tasked to

get the word out around town and track down bids for the

work.

Cuba designed storyboards from the description of the

scene in the script, and worked on the job at the University

of Illinois Chicago. A 2D drawing program that Cuba designed

with the GRASS language was modified to allow input of a

third Z axis for every point entered on the digitizing

tablet, creating the 3D representation of the Death Star

surface.

Using the Vector General based GRASS graphics system

designed by Tom DeFanti, Larry worked night and day for 12

weeks to produce 2 minutes of film of which 40 seconds

appeared in the final film sequence.

[RENDER TIME QUOTE] ³(While the GRASS system was capable

of real time animation) the real time capability came from

the Vector General's hardware implementation of basic

transformations, like translation, rotation and scaling.

also the projection transformation that turns a 3D object

into a 2D drawing, but it was only capable of a parallel

projection (that is, no 'true perspective'). Since I needed

perspective for this project, I was back to using software

for the projection and therefore \*not\* able to animate the

scene in real time. I was getting a frame rate of about two

minutes of computation per frame and so the whole shot

took about 12 hours.² ­Larry Cuba

(A rented Mitchell camera filmed the imagery off of the

computer monitor) The finished footage was originally

intended to be shot as a rear projected element live on stage

with the actors in London, but greatly reduced production

deadlines made that impossible. The full story as told by

Larry Cuba himself:

[QUOTE] ³Around two months from my deadline, I was sent

a production schedule and I noticed that the live action

shooting of the shot that my work was to be used in, was

scheduled a month earlier than the delivery date specified on

my contract. So instead of having two months left to finish

the shot, I had only one.

When I mentioned this to the Assistant Producer, he

informed me that it was even worse than that because they

required the film to be delivered 4 weeks earlier than

shooting in order to have time to make back up copies (should

anything happen to the footage during the live action

filming). So apparently, since I couldn't send out the shot

immediately, we were already dead in the water.

The 'solution' he came back to me with was that they

would rearrange the schedule and place that scene (the

briefing room scene) on the last day that they had the large

sound stage (they were shooting in England. All

communication went from me, in Chicago, to the Assistant

Producer in LA, to the Producer, Gary Kurtz in London and

then to Lucas and then the reverse trip back). This would

give me four more weeks to produce the shot (rather than the

eight that I thought I had).

So with my schedule cut in half, I stepped up

production. I was getting three hours of sleep a night by

sleeping on the sofa in the (over air conditioned) lab with

the computers. computers generate a lot of heat so computer

rooms need to be kept cool or the computers will fail to

work.

Working in this way, I was able to finish building the

computer model of the Death Star and program the fly through

sequence just in time for it to be filmed and sent off. But

once I started the film run (which had to run continuously

for 12 hours), the computer would crash about 30 minutes into

it. Up until this point, the occasional crash was not a

problem. reboot and keep going. But now this was a

disaster. I couldn't put the shot together filming in 30

minute bursts. (I could if I rewrote the program, but there

was no time for that now). We tried everything we could

think of to get the system to stop crashing. (we even took

the hard disk apart and cleaned it), but 30 minutes after

every start, the system crashed.

It was getting late on Saturday night and I had to put

the exposed film in the mail on Monday. By 3am (my bedtime),

I decided that it was useless. On Monday morning, instead of

sending out the film, I would have to call LA and tell them

that I had failed to deliver and that our only recourse at

this point was to shoot the scene blue screen and optically

print my animation in later.

Since there was no more hope, I figured I would at least

be more comfortable, so before I went to sleep, I turned off

the air conditioning so I wouldn't freeze, and I started the

shot from the beginning one more time (what the heck?). This

time it ran continuously throughout the night and Sunday

morning, completing the shot just in time.² ­Larry Cuba

There was traditional hand animation done for the final

four seconds of the bomb entering the death star exhaust port

and exploding; completed by John Wash at Image West.

Other computer graphic and video display images were

created for Star Wars by several different people. John Wash,

Jay Teitzell and Dan O¹Bannon at Image West created many

electronic video graphic effects for the targeting computers

and background tactical displays. Larry Cuba also completed

several graphics seen in the DeathStar guard room when R2 and

C3PO first tap into the central computer.

[SIGGRAPH FACTOID] The 1977 SIGGRAPH convention

Electronic Film Show also ended with Larry Cuba¹s work,

although not as planned. Halfway through his film ³First

Fig² all the power went out in the hotel bringing it, and the

show to a premature ending.

1978

ACM/SIGGRAPH in Atlanta, Georgia with about 1500 attendees

and 44 exhibitors.

Jim Blinn produces the first in his series of animations for

the The Mechanical Universe while at JPL.

Jim Blinn also publishes his technique of bump mapping,

completed as part of his graduate thesis at the University of

Utah the previous year. His demonstration of the new shading

code is shown as 128x128 resolution, 16 frame loop of a bumpy

sphere. His initial method of calculating both the angle and

amount of perturbation is later refined and simplified as an

altitude description, allowing for incremental gray scale

values to define intermediate angles of surface normals.

1979

ACM/SIGGRAPH in Chicago, Illinois with about 3000 attendees

and 79 exhibitors.

Edwin Catmull leaves NYIT to head the Lucasfilm Computer

Development Division. He is soon joined by Alvy Ray Smith,

David Di Francesco, Tom Duff and Ralph Guggenheim.

[QUOTE] ³In 1979, the most significant artistic event of

my career occurred: Ed Emshwiller and I created Sunstone.

It is primarily his piece, but we worked very closely on this

piece and I am still extremely proud of it. It is in several

museum collections of the world, including MOMA. Lance

Williams and Garland Stern also helped some on it.² ­Alvy Ray

Smith

The Black Hole (Disney): Opening grid/black hole

simulation. By John Hughes (Rythm and Hues) et al. at Robert

Abel & Associates.

Jim Clark designs his ³geometry engine², the basis for his

future company Silicon Graphics.

Alien: Alan Sutcliffe at Systems Simulation Ltd. Of London

created a computer monitor sequence showing a 3D terrain fly-

over, rendering computer-generated mountains as wireframe

images, with hidden line removal.

Meteor has vector graphics created by Triple-I

Julien Gomez developes TWIXT at Ohio State software used at

Cranston Csuri Productions.

Raytracing developed at Bell Labs & Cornell University.

Turner Whitted published a paper for SIGGRAPH 79 describing

raytracing techniques.

1980's

The first digital computers used in CG were those in

the Digital Equipment Corporation (DEC) line including the

early PDP-1, PDP10 and PDP-11 of the last decade. However

because of their cost and high maintenance, these were

restricted to large budget University and major production

settings. Typical of this work is Jim Blinn at JPL creating

the Voyager Flyby films, the Cosmos Series for Carl Sagan,

and the Mechanical Universe project; all from about 1979 to

1983.

The ³workstations² as we know it today were introduced

in the early 1980s by companies such as Apple Computer and

Silicon Graphics Inc.

The consumer market for personal computer graphics began

with the Macintosh personal computer and its MacDraw and

MacPaint software in 1984. The Xerox Alto did of course pre-

date the Mac by a decade, but did not reach personal use in

any numbers; it¹s initial market was government and

University settings.

Commercial CG production was boosted by the new

generation of digital machines such as the (MORE INFO!) and

the early Silicon Graphics workstations such as the IRIS 3130

in 1989. At the same time, third party companies began

providing specialized software to run on these new graphic

platforms. For 2D graphic design and image processing,

Photoshop was introduced for the Mac in 198?. Early 3D

animation software for the higher end market included

Wavefront(1987), Intelligent Light(198?), and Alias

v1.0(1984).

The mid 1980¹s to early 1990¹s were a time of tremendous

advances in technology and stunning creative breakthroughs.

Companies such as Robert Abel and Associates, Triple-I,

Magi/Synthavision, Omnibus, and Digital Productions created

such memorable images as Sexy Robot (ABEL), Chromosaurs

(PDI), and the Benson & Hedges(Digital Productions)

commercials.

The U.S. National Science Foundation began to provide

supercomputer access to university research programs,

including the University of Illinois Supercomputing Center.

1980

ACM/SIGGRAPH in Seattle, Washington with about 7500

attendees and 80 exhibitors.

LOOKER: Triple-I produces seven minutes of computer graphics

under the Direction of Richard Taylor et al. Polygonal models

of a complete human body were created.

Loren Carpenter's fractal extravaganza "Vol Libre" is

presented at SIGGRAPH 80

Loren Carpenter at Lucasfilm's Games Group & Atari created

"Rescue From Fractalus!"

Chris Briscoe and Paul Brown co-founded Digital Pictures as

the UK's first specialist computer animation company

1981

ACM/SIGGRAPH in Dallas, Texas with 14,000 attendees and 124

exhibitors.

Nelson Max begins making computer graphics for the IMAX film

format at Lawrence Livermore National Labs. Steve Levine and

George Matthews here also had lots of contact with NYIT in

the early days. They were making graphics of "superheated

spheres" (get it?)

Computer Assisted Animation Stand(CAAS) at NYIT Computer

Graphics Lab.

Omnibus Video Inc. is founded in Toronto Canada.

Adam Powers (The juggling tuxedo guy): Part of Information

International Inc. (III) demo reel shown at SIGGRAPH that

year.

Nintendo introduces the Donkey Kong video game

1982

ACM/SIGGRAPH in Boston, Massachusetts with about 17,000

attendees and 172 exhibitors.

Tom Brigham (NYIT) introduces the first full raster ³morf²

technique at the 1982 SIGGRAPH conference.

Silicon Graphics Inc. formed by Jim Clark (University of

Utah 197?) For lots of details see the ³Companies² chapter.

Autodesk formed by Dan Drake and John Walker, release Auto-

CAD v1.0 at COMDEX.

Mits Kaneko and the Japan Computer Graphics Lab (JCGL)

produce the series "The Yearling². Episode No. 2 was

broadcast in April 1982 and became the world's first

television animated program completely processed with a

computer. (See the Company history on JCGL for more details.)

The first all digital computer generated image sequence for a

motion picture film: Star Trek II: Wrath of Khan/genesis

sequence. Amazing use of fractal geometry and particle

systems, (by Loren Carpenter based on his own work from his

³Vol Libre² film, completed while at Boeing). Bill Reeves

fire, Tom Porters stars, and Tom Duffs moon. Conceived and

Directed by Alvy Ray Smith.

Tron (Disney)

The first extensive use of 3D CGI animation for a

feature film. This milestone project was originally boarded

by Bill Kroyer and Jerry Rees and pitched to Disney by Steve

Listberger. Bill and Jerry came up with the titles ³Computer

Image Choreographers² for their roles which were much more

than traditional Animation Directors. The model motion and

choreography, along with camera blocking and motion paths

were all sketched out in exacting detail to be passed on and

realized precisely by four CG production houses.

[TRON FACTOID] The largest format pencil tests ever! The

Disney art and animation team that were previsualizing the CG

for the film, never had any way to view a traditional pencil

test. The first time they got a chance to see their planned

motion scenes was only after the CG was created, rendered and

output to 70mm film. Because of a technical limitations at

Disney, the film was actually rear projected in the screening

room.

So who did what CG on TRON? Robert Abel & Associates

created the title sequence for the film, and the entry to the

digital computer world. Digital Effects created the little

bit character. Mathematical Applications Group Inc.

(MAGI) created the light cycles and most of the recognizers.

Information International Inc. (Triple-I) created

Sark¹s carrier, the solar sailer, and the MCP character

sequences near he end of the film.

In total, there was actually only about 15 minutes of

computer generated imagery created for the film, supervised

by Richard Taylor. The majority of effects were accomplished

by traditional animation techniques involving tens of

thousands of hand rotoscoped individual frames of artwork.

1982/83

Where the Wild Things Are (Test done at MAGI): The first

instance of digital compositing for motion picture work. The

character animation was done at Disney (lead by Glen Keane,)

and the cg backgrounds, rendering, painting, and compositing

was done at Magi/Synthavision. Jon Lasseter was the

official Disney-Magi liaison. Ken Perlin supervised the

project, with the CG work lead by Chris Wedge and Jan Carlee

(both now at Blue Sky.). Software was by Ken Perlin,

Christine Chang, Gene Miller, and Josh Pines. Look for many

more details in the Companies Chapter!

1983

ACM/SIGGRAPH in Detroit, Michigan with about 14,000

attendees and 195 exhibitors.

AVCO Finance spot shown at SIGGRAPH Electronic Theatre. (This

was the first fully rendered raster 30-second commercial

spot.)

Alias Research Inc. founded in Toronto Canada

The Bosch FGS-4000 (the first true turnkey 3-D System) is

introduced at NAB in 1983.

Cube Quest(Simutrek Inc.): Early 3D graphics video game.

Return Of The Jedi (Twentieth Century-Fox/LucasFilm Ltd.):

Holographic Endor moon sequence by the LucasFilm Computer

Graphics Group. Bill Reeves and John Lasseter did it using

vector graphics to simulate raster graphics!

1984

ACM/SIGGRAPH in Minneapolis, Minnesota with 20,390

attendees and 218 exhibitors.

Synthavision, a division of MAGI, is sold off to a Canadian

investment company.

Silicon Graphics releases it¹s first commercial product,

the IRIS 1000 terminal (which ran off a VAX host).

Wavefront software company formed in Santa Barbera, CA by

Bill Kovacks et al Š LOTS MORE

A modern global illumination rendering technique called

Radiosity is presented by a team led by Don Greenberg at

Cornell University.

The Apple Macintosh computer is released. The first

personla computer with a graphical user interface (GUI).

The Adventures Of Andre And Wally B. LucasFilm Computer

Graphics Division. Alvy Ray Smith directed John Lasseter in

his first CG short animated film.

[SIDEBAR NOT!] Dune: Cool 3D CGI body armor. NOT!

(Traditional animation done by Jeff Burks while at Van

derVeer Photo Effects.)

The Last Starfighter (Lorimar): The first CG project by

the new Digital Productions formed by Gary Demos and John

Whitney Jr. after having just left Triple-I.

2010: Odyssey Two: Digital Productions worked with Boss

Film Corp.¹s Richard Edlund. Larry Yaeger, Craig Upson, Neil

Krepela, et al. combined computational fluid dynamics with

CGI to create the planet Jupiter.

1985

ACM/SIGGRAPH in San Francisco, California with 27,000

attendees and 254 exhibitors.

Disney¹s The Black Cauldron is the first use of 3D computer

graphic elements in an animated film. (true?)

The first ever Academy of Motion Picture Arts and

Sciences award recognition for computer graphics

achievement: John Whitney Jr. and Gary Demos of Digital

Productions receive The Scientific and Engineering Award was

for ³the practical simulation of motion picture photography

by means of computer generated images (1984).

Bob Abel¹s Sexy Robot completed for the Canned Food Council.

The animated short film Tony de Peltrie by Phillipe

Bergeron shows at SIGGRAPH 85. Using digitized clay models,

and the new user friendly TAARNA 3D animation system (From U.

of Montreal) along with additional key frame interpolating

algorithms by Doris Kochanek described at the previous years

SIGGRAPH. (Phillipe also did hero animation on the Symbolic

short Stanley and Stella in 1985)

[SIDEBAR NOT!] Max headroom was NOT computer generated.

(Really, take my word for it.) Beginning with the 1985

British music video show and TV pilot, he was portrayed by

actor Matt Frewer in stylized makeup with added video editing

effects. The US TV series produced in 1987 did feature some

other on screen CG (created with an Amiga) but never Max

himself. (BTW, 10 years later actor Matt Frewer later stared

in the LawnmowerMan II sequelŠinfinately less good than Max

Commodore introduces the Amiga color personal computer.

Playland (Atari Corp.): Bill Kovacs.

Los Alamos National Lab: The Ultra-High Speed Graphics

Project is started. It pioneers animation as a visualization

tool and requires gigabit-per-second communication capacity.

An early massively parallel (128-node) Intel computer is

installed.

Young Sherlock Holmes: The stained glass knight sequence.

€The first CG Character in a feature film

€The first computer generated images in a feature film

to be exposed directly onto the film with a laser.

€One shot was also the first ever all digital composite

of CG with live action footage for a feature film. (The rack

focus shot that starts on the knight¹s hands grasping the

sword hilt and then tilts up to his face)

By the graphics group at LucasFilm LTD.

[FACTOID] David DiFrancesco built the ³digital film

printer² that was used for Young Sherlock Holmes. Designed as

one unit with three main components; a scanner and a printer

with a Pixar Image Computer in between. The former video

artist would later receive two separate Academy Awards for

his pioneering work. A Sci-Tech Award in 1994 for the scanner

portion, and a Technical Achievement Award in 1999 for the

printer work.

Money For Nothing MTV video by Dire Straits.(Steve Barron

director) Gavin Blair and Ian Pearson created the animation

at Rushes Post production in London, done on the Bosch FGS-

4000. The Quantel effects were done by Viv Scott. Ian and

Gavin now own and run a company in Vancouver called

Mainframe, out of which they produced Reboot(1994).

Cranston-Csuri produces many national broadcast network

graphics, but closes in 1987. Many of its employees go on to

later form MetroLight Studios (1987).

[BIO] Gary Demos: (studied under Ivan Sutherland at

Utah?) Š Cal Tech, went to work at E&S in 1972 and met John

Whitney Jr. Began working on projects with III then went with

Whitney to III to form the ³Motion Picture Design Group² in

1974. Left III just before Tron production, again with

Whitney, to form there own company Digital Productions. DP

filed for chapter 11 in 198? But was then continued as

Optimistic by Whitney. Demos the formed his own company,

which still exists today: DemoGraFX.

1986

ACM/SIGGRAPH in Dallas, Texas with about 22,000 attendees

and 253 exhibitors.

SoftImage founded in Montreal by Daniel Langois.

Mick Jagger's Hard Woman music video. Digital Productions

Brad deGraf, Bill Kroyer, Kevin Rafferty. Et al. CG Co-

Produced by Nancy St.John and Alan Peach.

"The Juggler": An Amiga demo by Eric Graham.

Digital Productions create the three minute opening

sequence for the feature film Labyrinth.

Complex 2D vector graphics character animation was produced

by Digital Productions for the Mick Jagger music video Hard

Woman.

PIXAR formed by Lucasfilm Computer Graphics Division pioneers

Edwin Catmull and Alvy Ray Smith along with about 35 others

including John Lasseter, Ralph Guggenheim, Bill Reeves, et

al. Purchased from George Lucas by Steve Jobs (Apple/NeXT)

for $10 million.

Luxo Jr. (PIXAR Animation Studios): First CG Short Animated

Film to be nominated for an Oscar for Best Short Animated

Film

Flight of the Navigator: Omnibus Computer Graphics creates

the silvery reflective spaceship. Contributors included Jeff

Kleiser(KWCC), Les Major(ILM) and Kevin Tureski(Alias)

The Great Mouse Detective: Disney first use of 3D computer

graphic elements in an animated film. (Or was it The Black

Cauldron in 1985?)

Howard the Duck: first digital wire removal for a feature

film. Painted by Bruce Wallace at ILM with proprietary

³Layerpaint² software on a Pixar Image computer. Layerpaint

code originally written by Mark Leather and modified by

Jonathan Luskin and Doug Smythe.

Star Trek IV: First use of Cyberware 3D scanner for film

Digital Productions is purchased(June), then also Robert

Abel & Associates (September), by Omnibus Computer

Graphics in 1986. Omnibus goes out of business one year

later on April 13th 1987.

1987

ACM/SIGGRAPH in Anaheim, California with about 30,541

attendees and 274 exhibitors.

Rhythm and Hues formed by ex-Abel staffers, opens in a

former dentist office.

Captain Power and the Soldiers of the Future

The first television series to include 3D characters

that were done entirely with computer animation. It went on

the air (September) in North America. Soaron and Blastarr

were two CG robots that appeared in the 22 episode series.

The computer animation was produced by Arcca Animation in

Toronto.

[SYNTHAVISION FACTOID] ³Arcca was the reformation of

Sythavision staff and software to do the Captain Power

series that was a creation of Landmark Entertainment

(Hollywood) and financed by Mattel. The show featured toys

that were interactive with the television show by registering

blast hits on the toy (via a 30hz flicker on TV) or on the TV

show character (via a trigger pull during a 15hz flicker from

the TV).² ­Paul Griffin

About four minutes of computer graphics was animated for

each episode every week using two SGI 3130 workstations

running Wavefront software. The motion was then ported over

to Sythavision data.

[ANIMATING WITH STICKS AND STONES] ³Animation was

incredibly arduous sometimes. First you'd plot the model and

the path of your animation on graph paper. Then input

hundreds or thousands of text lines in a form that

Sythavision would understand. If you were out as much as a

space or tab in your input file, it wouldn't run. To review

your animation, you played in back by flipping images through

a frame buffer that often time had pixels as big as postage

stamps and based on this make a decision as to whether or not

to send your rendered animation to the film recorder. Two

days later it would come back from the lab and you could see

where all the mistakes were and start over again. But it was

a beautiful renderer. The quality of the solid modelled

surfaces and the lighting routines made for some great

images.² ­Paul Griffin

Rendering was done on 13 Sun Workstations that ran a

proprietary job control system, that would pick up new frames

in a sequence as they were completed, which may have been the

first render farm of its time. The work for the show won

Arcca a Gemini Award (the pinnacle in Canadian film

production) for Technical Achievement in 1988.

The producer was Bob Robbins. The art director was Earl

Huddleston. Paul Griffin(ILM) was Animation Director, Andy

Varty, Sylvia Wong(Rhythm & Hues, ILM), Les Major (ILM,

Pixar). Paintbox work by Rob Smith and Mike Huffman.

Jenniffer Julich was in charge of storyboards. Rob Coleman,

was Arcca's onset liason/line producer. Mark Mayerson now

directs Monster by Mistake on DisneyTV and YTV (Canada). On

the live action production side, Doug Netter (Rattlesnake

Productions) and Larry Dittillo(sp?) (the writer) went on to

develop Babyon 5.

1988

ACM/SIGGRAPH in Atlanta, Georgia with about 19,000

attendees and 249 exhibitors.

Fruit Machine (Wonder World): The first all digital film

composite for a feature film outside the U.S. by Computer

Film Company (CFC)/London. Multiple film elements were

scanned into a computer, 100% digitally composited, and

filmed back out again.

­see the Companies chapter on CFC for more details

Jim Henson and Digital Productions create a real-time 3D

digital character for the Jim Henson Hour. The first of its

kind. Steve Whitmeyer(sp?) was the puppeteer and voice. Thad

Bier(PDI/Hammerhead) and Grahm Walters and Rex, shipped all

the equipment up to Toronto one week before SIGGRAPH. The

opening to the show was done by Jamie Dixon(PDI/Hammerhead).

Mike the Talking Head The first real-time character (aka

motion-capture, vactor, performance animation). Michael

Wahrman and Brad deGraf did it at deGraf/Wahrman live at

the SIGGRAPH Electronic Theatre in Atlanta. ( Mike was a

virtual caricature of the late Mike Gribble, the host of that

show, and the Mike of Spike and Mike's animation festival.)

Willow (MGM/Lucasfilm Ltd.): First feature film use of

digital morphing technology.

CAPS(Computer Animation Paint System) developed jointly

between Pixar and Disney.

Tin Toy (PIXAR Animation Studios): First CG Short Animated

Film to win an Oscar for Best Short Animated Film

1989

ACM/SIGGRAPH in Boston, Massachusetts with 27,000 attendees

and 238 exhibitors.

Indiana Jones and the Last Crusade (Lucasfilm Ltd.

/Paramount): Contrary to what you may have read elsewhere,

this was NOT he first all digital composite for a feature

film. (ILM¹s own Stained Glass Knight in Young Sherlock

Holmes, CFC¹s Fruit Machine, and Triple-I¹s Future World

all came before) The ³Donovan¹s destruction² sequence by ILM

was the first to use many multiple scanned film elements,

digitally composited, and then scanned back out to film with

a laser.

(By now it gets a little silly with all of the sub-sub

classifications of ³firsts² in areas such as these.)

The Abyss (GJP Productions/Twentieth Century-Fox): Water

Pseudopod.

1990's

The entertainment world as we know it began to change in

the 1980s when motion picture images in Tron, Star Trek II,

The Last Starfighter, and Young Sherlock Holmes gave the

audience a taste of the future. Now, George Lucas¹s

Industrial Light + Magic began to continuously raise the

popular standard by which all CG was judged by creating such

images as the water pseudopod in James Cameron¹s film The

Abyss (1989) and the T-1000 in Terminator 2: Judgment Day

(1990). In 1993 ILM smashed all previous conceptions about

computer graphics when Jurassic Park¹s photo-real dinosaurs

took center stage in theaters around the world.

1990

ACM/SIGGRAPH in Dallas, Texas with 24,684 attendees and 248

exhibitors.

The feature film ³Flight of the Intruder². Rhythm and Hues

created over 30 shots of photo-realistic aircraft, cluster

bombs, and smoke in full daylight..all with their own

proprietary software.

deGraf/Wahrman did The Funtastic World of Hanna-

Barbera, the first CG ridefilm. It was a fully 3D chase/ride

through Bedrock and Scooby-Doo's castle, with cel animated

characters, for Universal Studios Florida. (Additional CG

work by Rhythm and Hues)

Robocop 2 (Also by deGraf/Wahrman) was the first use

in feature films of Performance AnimationŠamong those who

also contributed were Ken Cope(animation) and Gregory

Ercolano(TD).

Kroyer Films creates the full length animated feature film

FernGully: The Last Rainforest. It contains 40,000 3D

hidden line computer plotted cel frames to augment the bulk

of the traditional animation. It also contains a digital-ink-

and-paint sequence by Sydney-Right, a feature film first.

The Rescuers Down Under: The first complete feature film

to be ³completely digital². The CAPS system digitally ink and

paints every frame of the film.

Die Hard 2:Die Harder (Twentieth Century-Fox): The first

digitally manipulated matte painting created at Industrial

Light & Magic. Matte department supervisor was Bruce Walters,

Paul Huston and Michael McAllister helped in design and

composition and Yusei Uesugi was the matte painter

extraordinare. Four separate images were digitized from the

painting (13 feet wide by 5 feet tall), decreasing in

resolution from the center outward. The images were assembled

in a MacII computer, and manipulated by Uesugi using

Photoshop. The image was combined with numerous live-action

elements of people, lights and steam with a camera move

programmed by Pat Myers.

NewTek releases the Amiga based Video Toaster.

1991

ACM/SIGGRAPH in Las Vegas, Nevada with about 23,100

attendees and 282 exhibitors.

Terminator 2: Judgement Day (Carolco): T-1000 liquid

metal cyborg

Beautiful all CG commercials by PIXAR for Listerine, Life

Savers and Tropicana set s new standard for broadcast

excellence.

Disney¹s Beauty And The Beast ballroom sequence is a major

new direction in feature length animated films.

1992

ACM/SIGGRAPH in Chicago, Illinois with 34,148 attendees and

253 exhibitors.

Death Becomes Her (Universal): Photoreal human skin and

body replacement.

1993

ACM/SIGGRAPH in Anaheim, California with 27,000 attendees

and 285 exhibitors.

Wavefront acquires the TDI software company from Thompson

Corp of France. In exchange Wavefront receives a major

capital investment from Thompson

PDI opens a Hollywood production office. This office would

close in a short few years.

Marc Scaparro, Eric Gregory and Brad deGraf did Moxy for the

Cartoon Network at Colossal Pictures. Produced by Anne

Brilz. It was the first live broadcast of a virtual

character.

Jurassic Park (Amblin/Universal): Photo-real 3D Digital

Dinosaurs

1994

ACM/SIGGRAPH in Orlando, Florida with about 25,000

attendees and 269 exhibitors.

Reboot: the first 100% CGI television series airs on ABC

from Mainframe Entertainment Inc.

Microsoft acquires Softimage

Forrest Gump (Paramount): Photoreal/invisible 3D and 2D

digital effects blending new footage with old, changing

archive footage, and removing Gary Sinese(sp?) legs! By ILM

of course.

Flintstones (Universal): First feature film digital hair

developed for the saber toothed tiger.

1995

ACM/SIGGRAPH in Los Angeles, California with 40,100

attendees and 297 exhibitors.

Silicon Graphics, Inc. acquires both Alias and Wavefront,

merging the two companies.

Toy Story (PIXAR Animation Studios): First full length CG

Animated feature film. Director John Lasseter wins a Special

Achievement Academy Award.

Judge Dredd (Cinergi): Early examples of fully 3D digital

stunt people by the Kleiser-Walzack Construction Company for

Mass-Illusion.

Casino (Dir. Martin Scorsese): Matte World Digital utilizes

LightScape software to seamlessly integrate a 1970s virtual

Las Vegas strip into present day live action footage. The

first time radiosity lighting was used in a feature film.

Batman Forever (Warner Brothers): Early example of 3D

realistic digital stuntman by Warner Brother Imaging

Technology (W.B.I.T.)and Pacific Data Images. Also a very

realistic, fully 3D cityscape by W.B.I.T.

Casper (Amblin/Universal): Record number of on screen shots

with a digital character. 400+

Jumanji (Tri-Star): Further development of particle based

digital hair technology for Lion sequence.

1996

ACM/SIGGRAPH in New Orleans, Louisiana with 28,800

attendees and 321 exhibitors.

Alvy Ray Smith, Ed Catmull, Tom Porter, and Tom Duff receive

a Technical Academy Award for digital image compositing

(ie the alpha channel)

Dragonheart (Universal): Breakthrough 3D CGI character

animation and lip-synch dialog.

Twister: Breakthrough realistic tornadoes and weather

effects by Industrial Light and Magic using Wavefront¹s

Dynamation..

1997

ACM/SIGGRAPH in Los Angeles, California with 48,700

attendees and 359 exhibitors.

Floops (done at Protozoa by Brad deGraf, Emre Yilmaz, Steve

Rein and others) was the first character distributed as 3D

(VRML), the first episodic cartoon on the Web, and the first

significant animation on the web (30 minutes worth).

Star Wars/Special Edition (Twentieth Century-Fox/LucasFilm

Ltd.): Restored and enhanced 20 year old film footage. About

350 shots were added or modified for all three films.

Spawn: Photo-real fully 3D creature transformations, full

screen digital stunt doubles, and dynamic simulated cape. All

with bone-cracking, digital-drool slinging realism.

Titanic: Large scale use of motion-capture and 3D digital

crowd extras.

[Quantel looses PATENTS ISSUE]

³British company Quantel has been asserting a set of

patents against companies for about a decade now, patents

that many of us in the digital imaging and computer graphics

business believed were invalid. These 1980s-vintage patents

covered airbrushing (digital painting with soft-edged

brushes), digital image compositing (!), pressure-sensitive

stylus, mixing paints on a window called a palette, etc. I

and my colleagues have long believed these notions to be too

simple to be worthy of "invention" hence patent coverage.

Furthermore, if anyone were to deserve credit for the

"invention", it certainly wasn't the Quantel people in the

1980s but rather several of the many practitioners (in the US

mainly) in the 1970s.

Jim Blinn, Lance Williams, and I tried to help save a

British company called Spaceward from these patents in a

London trial in 1989. We were unsuccessful, largely, I

believe, because we didn't have any hard evidence - no code,

no program. This changed in September 1997. Quantel sued

Adobe, well-known US producer of popular software products

such as Photoshop, for patent infringement on US versions of

the UK patents that had been held against Spaceward. The

trial was held in Wilmington, Delaware. The following

colleagues joined me in helping Adobe this time: Marc Levoy,

Christie Barton, David Em, Dick Phillips, Jim Blinn (by

deposition), and others.

The Adobe attorneys did a great job of gathering

evidence, including hard evidence this time. They obtained

actual code that I had written in 1977 and 1978 and

recompiled it under Windows. So I was able to demonstrate

directly to the jury exactly what we had done in the 1970s -

in this case I was showing the first full-color (RGB, or 24-

bit) digital paint program, which of course did many of the

things Quantel claimed to have invented in the 1980s! Marc

Levoy's 1978 full-color paint program (the second one) was

similarly found and recompiled and shown to the jury.

Long story short: The jury found all five patents at

issue invalid (and that Adobe was innocent of infringement).²

-Alvy Ray Smith

1998

ACM/SIGGRAPH in Orlando, Florida with ??? attendees and ??

exhibitors.

1998 saw an unprecedented number of SciTech awards go to

the computer graphics community. Individuals at Alias, Pixar,

PDI, Side Effects, SoftImage and Wavefront all were

recognized for various components of those systems.

In addition, several individuals were recognized for

their contributions to CG.

A Scientific and Engineering Academy Award was awarded

to Richard Shoup, Alvy Ray Smith and Thomas Porter for

their pioneering efforts in the development of digital paint

systems used in motion picture production. The award reads:

³Much of the foundation for the numerous contemporary digital

paint products for motion pictures can be traced directly

back to the early work of these digital pioneers.²

A Scientific and Engineering Academy Award was awarded

to Craig Reynolds for his pioneering contributions to the

development of three-dimensional computer animation for

motion picture production. The award reads: ³The early

contributions of Mr. Reynolds in the digital animation arena

have become both influential and instrumental in the

architecture of many later systems developed at companies

throughout the computer animation industry.²

Geri's Game (Pixar): Academy Award winning animated short

film showcases the newly rediscovered modeling technique of

subdivision surfaces.

Bingo (Alias|Wavefront) Chris Landreth¹s test piece for the

initial Maya release received a Genie Award from The Academy

of Canadian Cinema and Television. It was named Best Computer

Animation at Ottawa 98 and at Imagina in Monaco, Bingo also

received an award from France's Societe des Auteurs et

Compositeurs Dramatiques (SACD) for "Most Innovative Story

and Production".

Antz is released (PDI/Dreamworks)

A Bug's Life (Pixar/Disney)

1999

Autodesk merges it¹s newly acquired Discreet Logic

(Montreal) division with its Kinetix (SanFrancisco) division

into the new Discreet entertainment division.

May 19th, 1999 Star Wars/Episode 1: The Phantom Menace

Almost 2000 state-of-the-art digital effect shots, most

of which are created at Industrial Light & Magic in less than

two years production time. The Gungan JarJar Binks is the

first all digital leading character in a motion picture.

The few shots that were not effects related were also

scanned and color corrected to produce a full digital master.

Later that summer, LucasFilm premiers the film in New

York and LA with a new electronic projection system. The

Texas Instruments system uses 1920x1080 progressive video

resolution to project the film at 24fps directly from digital

storage.