



TÉCNICAS AVANZADAS DE
ANIMACIÓN POR COMPUTADORA

Técnicas Avanzadas de Animación por Computadora

- * Dra. Claudia Esteves Jaramillo
- * Oficina: primer piso edificio blanco DEMAT.
- * La mejor forma de contactarme es por e-mail: cesteves@cimat.mx
- * Página web del curso: <http://www.cimat.mx/~cesteves/cursos/animation/index.php>
- * Lugar y hora: Salón 4 CIMAT de 11h00 a 12h30 los lunes y miércoles.

Objetivos del curso

- * Recorrer las técnicas más comunes y recientes en el área de CA tanto en la academia como en la industria.
- * Al final del curso deberán conocer:
 - * diferentes técnicas para generar movimiento automático y herramientas que se pueden utilizar.
 - * dónde obtener la literatura más reciente en el área de CA.
- * Prerrequisitos:
 - * Álgebra Lineal.
 - * Programación orientada a objetos C/C++.
 - * Cálculo de vectores.

Algunas referencias

- * R. Parent. Computer Animation: Algorithms and Techniques. Morgan Kaufman, 2007.
- * K. Erleben, J. Sporring, K. Henriksen, H. Dohlmann. Physics-based animation. Charles River Media, 2005.
- * Artículos y referencias en cada tema.

Forma de calificar

- * 5 mini-proyectos (70%)
 - * Animación por keyframes.
 - * Sistemas de partículas.
 - * Simulación de cuerpos rígidos con y sin colisiones.
 - * Captura de movimiento o cinemática inversa.
- * Presentaciones de papers, discusiones, preguntas y otras tareas (todos leen los papers, no solo el que presenta) - 30%
- * El límite de entrega es a las 23h59 del día que se pidió.
- * 20% de reducción sobre la nota máxima del proyecto por cada día de retraso.
- * La clase toma tiempo!
- * Grupo Google o Facebook recomendado.

Algunos temas

- * Animación basada en keyframes.
- * Técnicas de interpolación.
- * Representaciones de orientaciones.
- * Modelación de sistemas jerárquicos (FK, IK).
- * Dinámica de partículas.
- * Dinámica de cuerpos rígidos.
- * Cuerpos rígidos articulados.
- * Cuerpos rígidos deformables.
- * Técnicas de captura de movimiento.
- * Animación para multitudes.

Descripción del curso

Estudiar aspectos computacionales del movimiento.

Representación, modelación, análisis y simulación del movimiento y su relación con otras áreas: geometría computacional, robótica, visión por computadora, simulación física, etc.

Computer Animation

* In Computer Animation any value that can be changed, can be animated:

* position,

* orientation,

* shape,

* shading parameters,

* camera parameters, etc.

Perception

- **Persistence of vision:** a sequence of still images seen at a given rate give the illusion of motion.

Afterimage

Perception

- When the image does not advance rapidly enough we see it as discontinuous and we say there is **flicker**.
- The eye-brain gets the impression of a sequence of static images.
- **flicker-rate**: rate at which the flicker varies depending on the illumination and viewing distance to the image.

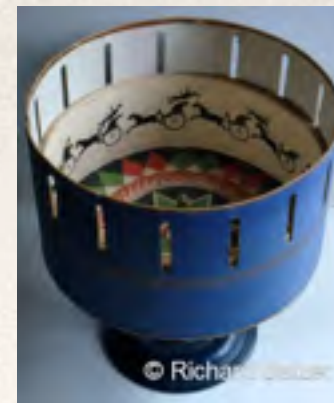
Perception (2)

- Persistence of vision (POV) \neq Perception of motion.
- **POV** \rightarrow lower limits of continuity in the image.
- **Motion blur** \rightarrow upper limits of continuity in the image.
- The **blur** comes from mechanical limitations of the eye such as blinking and tracking and light sampling.
- In computer animation the **blur** has to be computed explicitely.
- **Playback rate** : number of images that are displayed every second (e.g. 30 fps)
- **Sampling rate**: number of different images that occur per second (e.g. 6 fps)



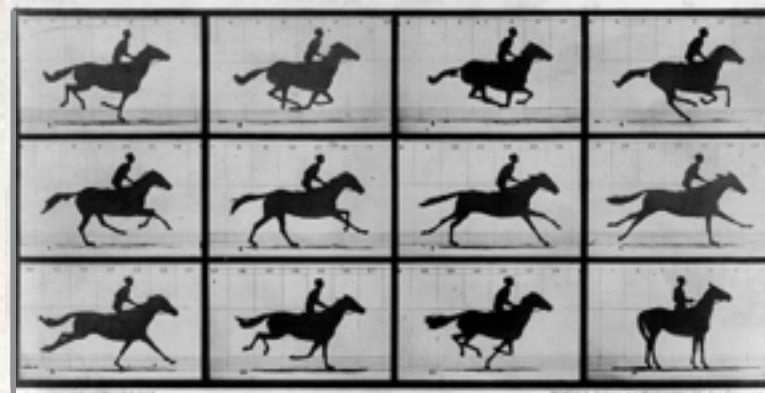
Thaumatrope¹

1825



Zoetrope²

1870



"Horse in Motion"¹
Eadweard Muybridge

1878



"High Jump"³
Etienne-Jules Marey

1886



First use of a camera
to make lifeless
things to appear to
move!
George Méliès

1896

1800s

1835

Phenakistiscope²



1877

Praxinoscope²
Emile Reynaud



1879

Zoopraxiscope¹
E. Muybridge



1882

Chrono-
photographe¹
E. Marey



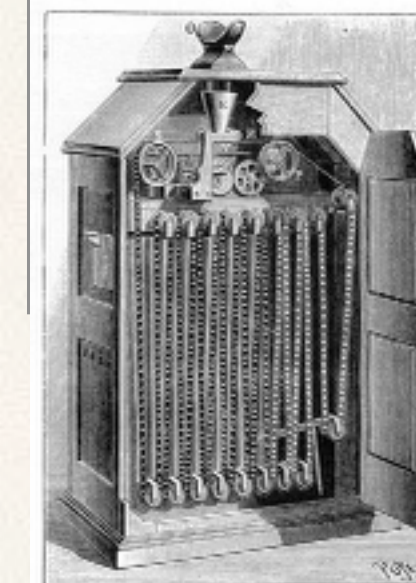
1886

Flipbook¹



1891

Kinetoscope¹
Thomas A.
Edison



1895

Cinematograph¹
Lumière Brothers



First Animation Devices

¹ wikipedia

² The Richard Balzer Collection (www.dickbalzer.com)

³ <http://www.theslideprojector.com/photoI/photoI/twodaylectures/photoI/lectureII.html>



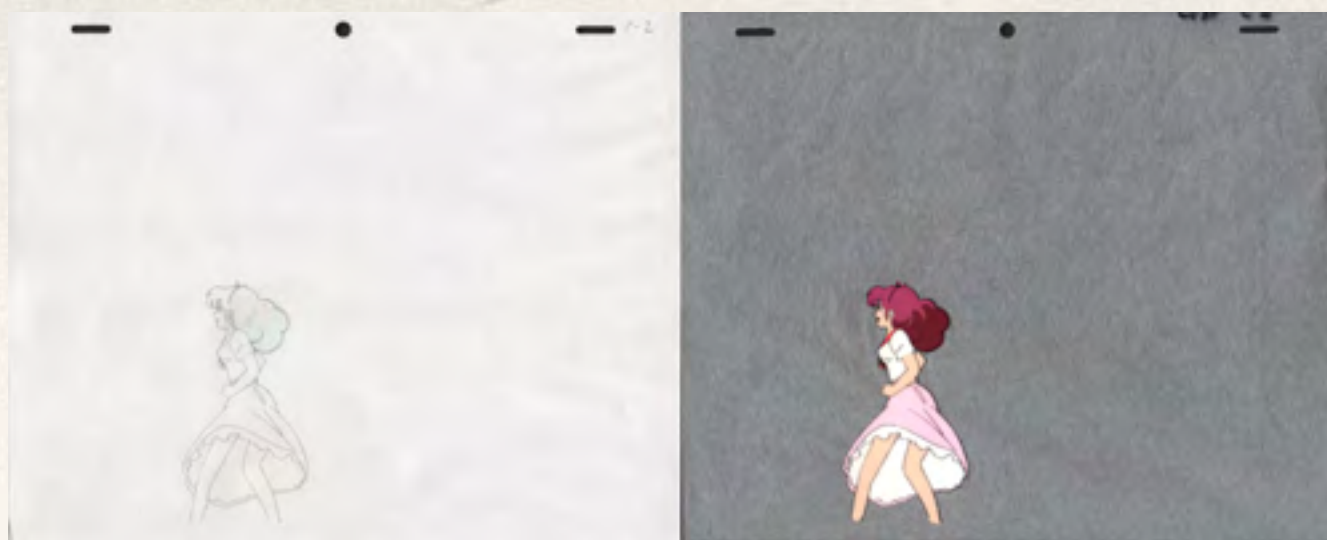
J. Stuart Blackton
“Humorous Phases of
Funny Faces¹” - smoke
special effects

1906



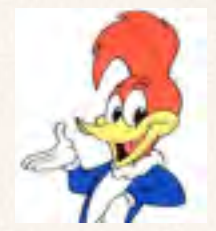
Winsor McCay
“Gertie the dinosaur”
First popular
animations

1914



John Bray's studio

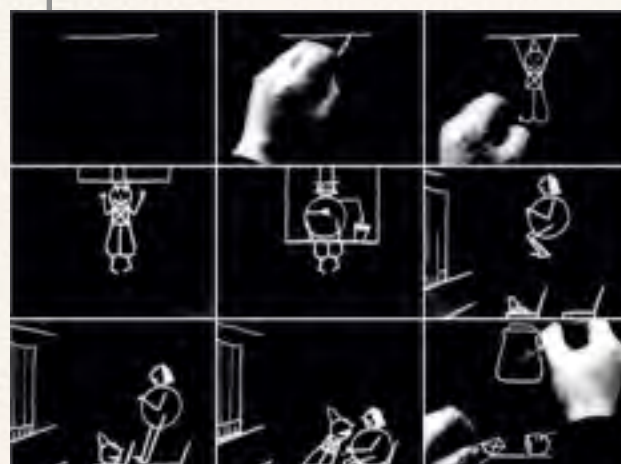
- First technical developments:
- translucent cells for multiple layers
 - grayscale drawings vs. black and white.
 - backgrounds in large pages to do camera translations easily.
 - Max Fleischer, Paul Terry, George Stallings, Walter Lantz.



1900-1930

1907

Emile Cohl
“Fantasmagorie¹”



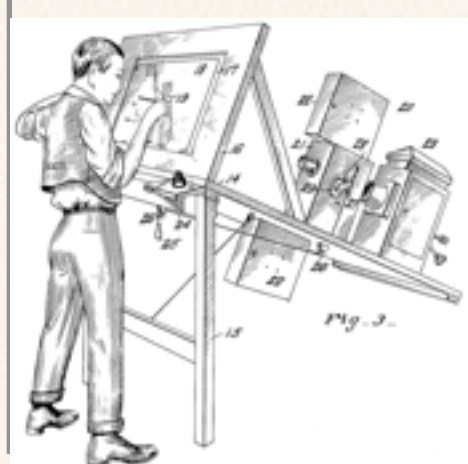
1911

Winsor McCay
“Little Nemo in
Slumberland.”
first color animation



1915

Max Fleischer
Rotoscoping²



1920

John Bray
experimented
with color in
the first
animated
cartoon “The
Debut of
Thomas Cat”



1925

First animated character
with identifiable
personality: Felix the Cat
by Otto Mesmer from
Pat Sullivan's Studio.

late 1920s

Walt Disney
Animation Studios³



Conventional Animation

¹ <http://www.inkwellimagesink.com/pages/articles/CentennialOfAmericanAnimation.shtml>

² wikipedia

³ <http://www.disneyanimation.com/aboutus/history.html>

Technical advances Disney Animation Studios (1930s)

- Use of storyboard to review the story and pencil sketches to review motion.
- Pioneered sound and color in animation.
- Used sound for the first time in “Steamboat Willie” (Ub Iwerks - 1928).
- Multi-plane camera - each plane can move in six directions. Moving multiple planes at different rates can produce the **parallax effect**.
 - illusion of depth, closer objects moving faster, motion blur.
- First full-length animated movie: “Snow White and the Seven Dwarfs” (1937).
- Stereo sound: “Fantasia” (1940).
- Endearing personalities to characters: Mickey Mouse, Pluto, Goofy, Three Little Pigs, 7 Dwarfs.

Stop-motion



Willis O'Brien,
"King Kong"
1933



Nick Park
Wallace and Gromit,
"A Grand Day Out"
1989



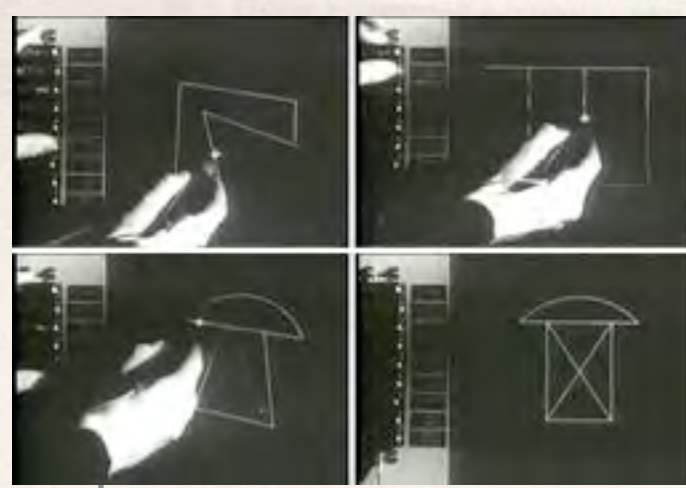
Tim Burton
"Nightmare Before
Christmas"
1993



Ray Harryhausen,
"Mighty Joe Young"
1949



Ray Harryhausen,
"Jason and the Argonauts"
1963



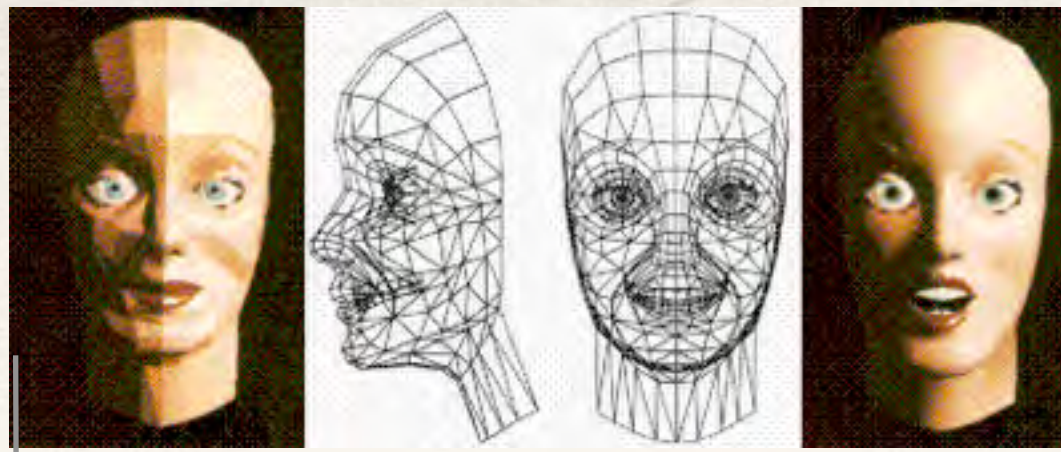
Ivan Sutherland (MIT).
Interactive constraint
satisfaction system on a
vector refresh display.

1963



Ed Catmull (U.
of Utah). "An
animated hand"

1970

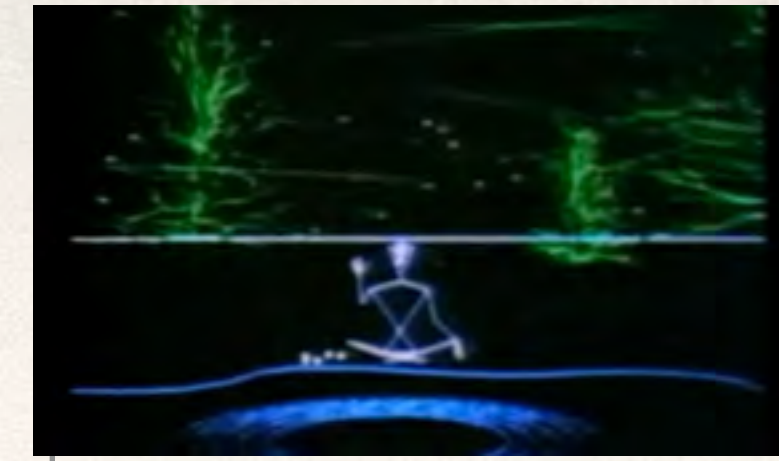


Fred Parke (U. of Utah). "Talking Face"



First CA nominated for
an Academy Award:
Hunger by Peter Foldes.
2.5D system.

1974



Dream Flight / Vol de Rêve.
Daniel Thalmann & Nadia
Magnenat-Thalmann. U.
Montréal.

1982

1960-1988

1968

Evans and
Sutherland (U. of
Utah) established
the first
significant
research program
in CG and
animation.

1973

A walking and
talking human
figure by Barry
Wessler. "Not Just
Reality".



1975

Norm Badler (U.
Pennsylvania)
Research on human
simulation and
posing



late 1970s

New York Institute
of Technology.
Produced several
CA thanks to Ed
Catmull and Alvy
Ray Smith. Feature
Film: The Works

1977



Star Wars CG
sequence
produced from
Ohio State
University.

1988



Rendez-vous à Montréal.
Daniel Thalmann & Nadia
Magnenat-Thalmann. U.
Montréal.

Computer Animation Research



Flight Simulators.
Evans and
Sutherland
Corporation



Waves and
Molecules.
Carla's Island.
Nelson Max.

1981

Alias, Wavefront, TDI
appear. Software tools and
advanced rendering
software.

3D computer
animated logos. Demo
reels at SIGGRAPH.



Pixar's The
Adventures of Wally
B. First CA
demonstrating
motion blur

1984



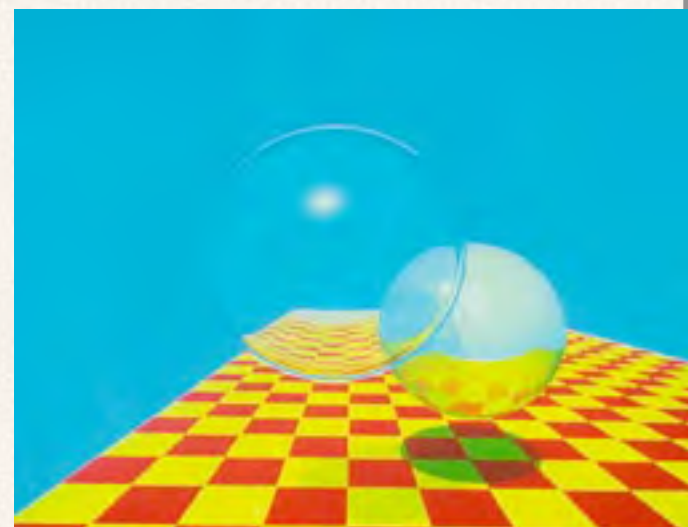
Pixar's Tin Toy. First
to win Academy
Award. Human
Character.

1988

1980s

1980

Anti-aliased Ray
Tracing. Turner
Whitted.



1982

Fractal terrains.
Vol Libre. Loren
Carpenter.

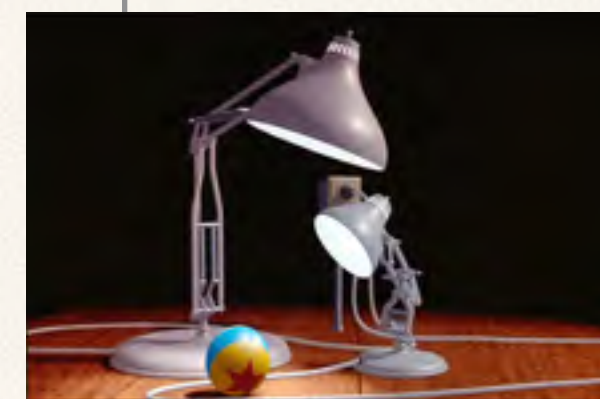


Walt Disney's Tron

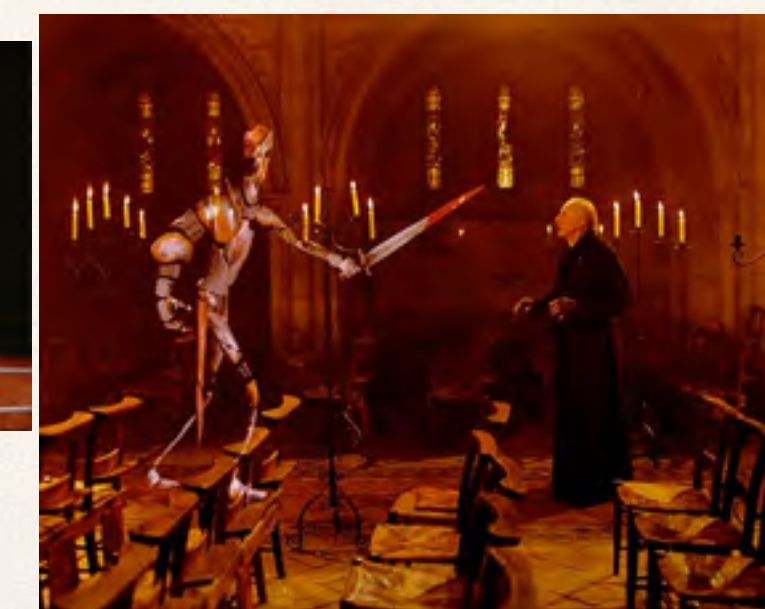


1986

Pixar's Luxo Jr.
Nominated for
Academy Award.
Lighting, Shadows
and Textures



ILM's Young Sherlock
Holmes. First to
place a synthetic
character in live
action feature film.



Computer Animation Industries Emerge



ILM's The Abyss. First example of CGI water.

1989



ILM's Forrest Gump.

1994



Dreamwork's Antz. First CGI film to feature over 10,000 individually animated characters in crowd scenes.

1998



Square Pictures' Final Fantasy. Photo Realistic Effects

2001



The Polar Express. Mocap technologies to animate characters.

2004

late 1980s - 1990s



ILM's Terminator 2: Judgment Day. Morphing effects. First film to use personal computers to create special effects.

1991



ILM's Casper. First feature film with a digitally created CG character as leading role.

1995



Pixar's Toy Story. First feature-length film entirely made by CA.



The Matrix. Manex Visual Effects popularized bullet time effect.

1999



Star Wars Episode I. Completely CGI fully articulated humanoid character Jar Jar Binks.

Cg Special Effects

<http://www.filmsite.org/visualeffects.html>



King Kong (2005) - WingNut Films



Pirates of the Caribbean: Dead Man's Chest (2006) - Industrial Light and Magic



Spider-Man 3 (2007) - Sony Pictures Imageworks



The Curious Case of Benjamin Button (2008) - Digital Domain



Avatar (2009) - Industrial Light and Magic



Harry Potter and the Deathly Hallows, Parts I and II (2010, 2011) Double Negative



Pirates of the Caribbean: On Stranger Tides (2011) Industrial Light and Magic



Cowboys and Aliens (2011) Industrial Light and Magic



Lectura

- * Para el próximo lunes leer el artículo:
- * Agarwal, et. al. Algorithmic issues in modelling motion. ACM Computing Surveys. 34(4) p.p. 550-572. Dec. 2002.