Computer Animation
Algorithms and Techniques

Introduction
Computer  
Using a computer

Animation  
Moving things that can’t move themselves

Techniques  
“artistic” animation - key frames & interpolation 
data-driven animation - mocap 
procedural animation - physics, behavioral

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Computer Animation
Perception

- Persistence of vision - positive afterimage
- Perception of motion - beta motion
- Flicker, critical flicker frequency
- Motion blur
- Update rate v. display rate
- NTSC - 39.95 fps, interlaced, 640x480
The Heritage of Animation

Early devices

Conventional animation

Disney

Stop Motion Animation
Early Devices

Flipbook
Thaumatrop
Zoetrope
Lumiere brothers
Edison
Conventional Animation

Winsor McCay

Stuart Blackman
Disney

Camera stand

Rotoscopying

Art form
Stop Motion Animation

Willis O’Brien

Ray Harrihausen

Nick Park

Tim Burton
Principles of Animation

9 old men of Disney
Illusions of Life
Art form

Squash and stretch
Arcs
Secondary action
Slow in & slow out
Anticipation
Exaggeration
Solid drawing
Appeal
In-between v. straight ahead
Follow-through
Staging
Principles of Animation

Simulating physics
Make it appealing
Effective presentation
Production alternatives

- Squash and stretch
- Arcs
- Secondary action
- Slow in & slow out
- Anticipation
- Exaggeration
- Solid drawing
- Appeal
- In-between v. straight ahead
- Follow-through
- Staging

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Computer Animation
Principles of Filmmaking

they have rules and guidelines!

180 degree rule
rule of thirds
types of shots
3-point lighting
tilt
framing
focus the viewer’s attention
Production->sequence->shot->frame
Storyboard: the proposal
Model sheet: consistency
Animatic: storyboard with timing
Key frames & in-betweens
Test shot
Pencil tests
Inking: drawings onto cells
Painting: coloring in
Sound: voice, body, special effects, background
Computer Animation Production

Pencil tests - rendering controls
  shadows
  physics
  articulation
  textures
  facial animation
Digital Media

cheap digital storage - high resolution

no degradation

digital recording process, digital display process

digital special effects
Pencil tests & Motion studies

Place holder objects
   Levels of Detail
   solids of revolution

Partial renderings
   shadows
   texture
   reflections

Interpolated movement
CA
Production
Tasks

- Story Dept.
  - Art Dept.
    - Modeling Dept.
    - Lighting Dept.
      - Animation Dept.
        - Rendering Dept.
Digital Media

Digital editing
Digital video
Digital audio
History of Computer Animation

Early activity

The middle years

Animation comes of age
Early Activity

Utah - first in graphics: DoD
  Evans & Sutherland, Frank Crow, Ed Catmull, Jim Blinn
CMU - Don Greenberg, Architecture
  Michael Cohen, Andrew Witkin, Barr, Jessica Hodgins
Ohio State - Artistic animation, Chuck Csuri
  zGrass, Dave Zeltzer, Doug Roble
U. Penn - Norm Badler - human figure animation
N.C. State - John Staudhammer,
  Early hardware raster displays
N.Y.U. - Utah graduates: Ed Catmull, Alvy Ray Smith
Montreal - Daniel Thalmann & Nadia Megnenat-Thalmann
The Middle Years: the 80's

Pixar - six shorts; first to win Academy Award

The Works - NYU

Young Sherlock Holmes - first CG character

Tron - first extensive use of CG

The Last Starfighter - first synthetic space ship

Future World - first use of CG

Looker - first CG character

The Abyss - first CG blobby particle system effect
CA comes of age! : the 90's breakthrough films

Terminator 2 - extensive use of CG effects

Jurassic Park - first integrated CG figures

Batman Returns - first use of CG stunt double

Jumanji - first use of real CG figures

Titanic - extensive use of CG human figures

Star Wars - first major CG character

Final Fantasy - most realistic use of CG human figures
CA comes of age!

Use of CG in traditional animation

Beauty and the Beast - CG environment (ballroom)

Tarzan - hand-drawn figures in CG environment (trees)

Prince of Egypt - CG figures in hand-drawn environment

Lion King - flocking control of wildebeast stampede
CA comes of age!

Use of CG astraditional animation

Toy Story
Shrek
ANTZ
Cars
Etc.

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CA comes of age!

Other notable films

Saving Private Ryan - extensive use of CG sets & doubles

LotR - extensive use of CG effects, characters

Spiderman, Batman, ....