CS 4732: Computer Animation

Introduction

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Course Goals

- Interpolation techniques
- Forward and inverse kinematics
- Physics-based animation
- Behavioral animation
- Computational issues
- History of (computer) animation
- Production technology
- Motion capture
- Do some cool stuff!
Assessment

- **20%** Weekly quizzes on textbook material
  - Keep up!

- **20%** Weekly paper summaries
  - Seminal (read: old) papers

- **30%** Regular programming projects
  - Individual

- **30%** Final project
  - Done in groups of two
  - Go deeper into one/more areas
Final Project

- Some examples
Regular Projects (tentative)

- Project 0: Hello, Animated Cube!
  ■ Due this Thursday!
- Project 1: Follow a spline
- Project 2: Physics-based motion
- Project 3: Articulated Figures
- Project 4: Behavioral Animation
- ???
- Examples
What is Computer Animation?

☐ You tell me!
## Traditional vs. Computer Animation

<table>
<thead>
<tr>
<th>Traditional Animation</th>
<th>Computer Animation</th>
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<tbody>
<tr>
<td>Image-based</td>
<td>Model-based</td>
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<tr>
<td>Individual cels drawn and painted</td>
<td>Objects change over time, individual scenes rendered</td>
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<tr>
<td>Key frames and in-betweening</td>
<td>Key frames, procedural, behavioral</td>
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<tr>
<td>Imprecise, inconsistent (artifacts, missing elements)</td>
<td>Exact or random perturbation, consistent across scenes</td>
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<tr>
<td>Show a Disney animation</td>
<td>Show Andre and Wally B.</td>
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History of Traditional Animation

- 1831 - phenakistoscope - slits on disk, images on second disk, rotated, view in the mirror, see http://courses.ncssm.edu/gallery/collections/toys/opticaltoys.htm
- 1834 - zoetrope - vertical slits on rotating cylinder, images below slits
- 1889 - Edison shows 13 seconds of film on kinetoscope (personal viewer)
- 1895 - cinematograph (projector)
- 1906 - first animated film (humorous phases of funny faces)
- 1908-1913 - several animations based on comic strip characters
- 1915 - cel animation invented
- 1926 - first feature-length animated film
- 1928 - Walt Disney produces Mickey Mouse - first with synchronized sound
History of Computer Animation

- 1957 - first analog computer animation
- 1961 - first digital computer animation
- 1961 - first digital computer game (space wars)
- 1965 - first animation language (BEFLEX)
- 1973 - Westworld - first significant entertainment film to use computer animation
- 1982 - Tron - significant number of computer generated scenes
- 1984 - The adventures of Andre and Wally B. - first with motion blur
- 1988 - Tin Toy - wins Academy Award
- 1999 - Geri's Game - wins Academy Award
- 1999 - Jar-Jar Binks - first humanoid synthetic actor integral to movie
Definitions

- Animate - to give life to or cause to come alive
- Persistence of vision - individual frames shown quickly enough will appear to possess continuous motion
- Presentation - a film consisting of one or more acts
- Act - an episode with an associated staging area consisting of many scenes
Definitions (cont.)

- Scene - a venue of continuous action consisting of one or more shots
- Shot - a continuous camera recording creating multiple frames
- Frame - an individual picture
- Motion Control - computer specification of changes in shape, position, orientation, and other object attributes
- Flying Logos - simple animation of the position/orientation of rigid objects

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Definitions (cont.)

- Splines - parametric equations used throughout motion specification
- Articulated motion - connected components whose motion are interrelated
- Free form deformation - non-rigid object creation and modification
- Procedural animation - mathematical model used to control motion
- Stochastic animation - statistical techniques for object creation/motion
Definitions (cont.)

- Behavioral animation - specify motion as interaction with environment (e.g., flocks)
- Kinematics - study of geometric and time-related properties of motion
- Forward kinematics - given joint angles and link lengths, where is end?
- Inverse kinematics - given end and link lengths, what should joint angles be
Principles of Animation

- Squash and Stretch
  - Deforming implies mass and rigidity

- Timing
  - Speed and acceleration implies size and weight

- Anticipation
  - Direct attention, moving joints to prepare to move

- Staging
  - Presentation of an idea, personality, feeling in a clear manner
Principles of Animation (cont.)

- Follow Through and Overlapping Action
  - Stopping one and lead in to next

- Pose-to-pose vs. Straight-ahead Action
  - Key frame vs. procedural or free-form evolution

- Slow-in and Slow-out
  - Adjust spacing for better continuity between extremes

- Arcs or Curves
  - Natural motion is rarely linear
Principles of Animation (cont.)

- Exaggeration
  - Accentuate effect to insure proper viewer interpretation

- Secondary Action
  - Subordinate motion caused by primary motion; add complexity

- Appeal
  - Characters must be enjoyable to viewers
Principles of Filmmaking

- Three-point lighting
  - Key light, fill light, rim light

- 180° rule
  - Shot changes between two characters should have the camera on the same side

- Rule of thirds
  - Place interesting things off-center by 1/3

- Types of shots
  - Camera placement affects feeling
Principles of Filmmaking (cont.)

- **Tilt**
  - Tilting the camera conveys strangeness

- **Framing**
  - Allow enough room for the action to take place

- **Focus the viewer’s attention**
  - Use lighting, depth of field, converging lines, character gaze, etc.
Examples

- Train
- Butterflies