



WPI

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



Traditional Animation

- ❑ Image-based
- ❑ Individual cels drawn and painted
- ❑ Key frames and in-betweening
- ❑ Imprecise, inconsistent (artifacts, missing elements)
- ❑ Show a Disney animation

Computer Animation

- ❑ Model-based
- ❑ Objects change over time, individual scenes rendered
- ❑ Key frames, procedural, behavioral
- ❑ Exact or random perturbation, consistent across scenes
- ❑ Show Andre and Wally B.

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 kinoscope (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

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