CS-184: Computer Graphics

Lecture #17: Introduction to Animation

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Administrative

- You should have turned in project proposal
- Assignment #4 due April 14th
Today

- Tessellation
- Introduction to Animation

Adaptive Tessellation

- Recall early discussion of curve drawing

Original
Uniform Sampling
Adaptive Sampling
Adaptive Tessellation

- Midpoint test subdivision

Possible problem
Adaptive Tessellation

- Midpoint test subdivision
- Possible problem
  - Simple solution if curve basis has convex hull property

If curve inside convex hull and the convex hull is nearly flat: curve is nearly flat and can be drawn as straight line

Better: draw convex hull
Works for Bézier because the ends are interpolated

Bézier Subdivision

- Form control polygon for half of curve by evaluating at \( u=0.5 \)

Repeated subdivision makes smaller/flatter segments
Also works for surfaces...
Adaptive Tessellation

- Given surface patch
  - If close to flat: draw it
  - Else subdivide 4 ways

Adaptive Tessellation

- Avoid cracking

Passes flatness test

Fails flatness test
Adaptive Tessellation

- Avoid cracking

Crack in the surface

Cracks may be okay in some contexts...

Adaptive Tessellation

- Avoid cracking
Adaptive Tessellation

- Avoid cracking

Test interior and boundary of patch
Split boundary based on boundary test
Table of polygon patterns
May wish to avoid “slivers”

Introduction to Animation

- Generate perception of motion with sequence of image shown in rapid succession
  - Real-time generation (e.g. video game)
  - Off-line generation (e.g. movie or television)
Introduction to Animation

- Key technical problem is how to generate and manipulate motion
  - Human motion
  - Inanimate objects
  - Amorphous objects
  - Control

Introduction to Animation

- Technical issues often dominated by aesthetic ones
- Violation of realism desirable in some contexts
- Animation is a communication tool
  - Should support desired communication
  - There should be something to communicate
Introduction to Animation

From Parent, p.15

Computer Animation Pipeline
Introduction to Animation

For more detailed diagram, see Kerlow p.54
Introduction to Animation

- Key-frame animation
  - Specification by hand
- Motion capture
  - Recording motion
- Procedural / simulation
  - Automatically generated
- Combinations
  - e.g. mocap + simulation

Key-framing (manual)

- Requires a highly skilled user
- Poorly suited for interactive applications
- High quality / high expense
- Limited applicability
Motion Capture (recorded)

- Markers/sensors placed on subject
- Time-consuming clean-up
- Reasonable quality / reasonable price
- Manipulation algorithms an active research area

Motion Analysis / Performance Capture Studio

Okan Arikan

Motion Editing

Arikan, Forsyth, O’Brien, SIGGRAPH 2002
Motion Editing

Arikan, Forsyth, O’Brien, SIGGRAPH 2002

Model Construction

Kirk, O’Brien, Forsyth, CVPR 2005
Simulation

- Generate motion of objects using numerical simulation methods

\[ x(t) + \Delta t = x(t) + v_t + \frac{1}{2} a_t \Delta t^2 \]

Simulation

- Perceptual accuracy required
- Stability, easy of use, speed, robustness all important
- Predictive accuracy less so
- Control desirable
Simulation

What to do with animations?

- Video tape
- Digital video
- Print it on yellow sticky notes
Video Tape

- Analog tape formats
  - VHS/SVHS
  - Beta SP
  - 3/4” U-matic
- Digital tape formats
  - Digi Beta
  - DV Tape
  - DVD (yes, I know DVDs are not tapes)

NTSC Standard

- Used by DVD, DV, and VHS
- 720x486 resolution (sort of)
- 1.33 aspect ratio
- Limited color range
- 30 frames per second (sort of 29.97)
- Interlaced video
- Overscan regions
Digital Video

- Wide range of file formats
  - QuickTime
  - MS Audio/Visual Interleaved (AVI)
  - DV Stream
  - Bunch ‘o images
- Some formats accommodate different CODECs
  - Quicktime: Cinepak, DV, Sorenson, DivX, etc.
  - AVI: Cinepak, Indeo, DV, MPEG4, etc.
- Some formats imply a given CODEC
  - MPEG
  - DV Streams

Digital Video

- Nearly all CODECs are lossy
  - Parameter setting important
  - Different type of video work with different CODECs
  - Compressors not all equally smart
  - Compression artifacts are cumulative in a very bad way
- Playback issues
  - Bandwidth and CPU limitations
  - Hardware acceleration
  - Missing CODECs (avoid MS CODECs and formats)
Path to Tape

- Not much of an issue any longer
  - Cheap ( < $100 ) devices can give good amateur quality output
  - Pro quality also cheap ( < $5000 )
  - Beware many cheap solutions over use compression
  - Good analog tape decks still expensive

Editing

- Old way:
  - Multiple expensive tape decks
  - Slow
  - Difficult
  - Error prone
- New way:
  - Non-linear editing software
    - Premiere, Final Cut Pro, others...
  - Beware compressed solutions
  - May take a long time for final encoding
Motion Blur

- Fast moving things look blurry
  - Human eye
  - Finite exposure time in cameras
- Without blur: strobing and aliasing
- Blur over part of frame interval
  - Measured in degrees (0..360)
  - 30 tends to often look good

Motion Blur

- Easy to do in a sampling framework
- Interpolation is an issue
motion Blur

- Velocity based blur often works poorly