CS-184: Computer Graphics

Lecture #18: Introduction to Animation

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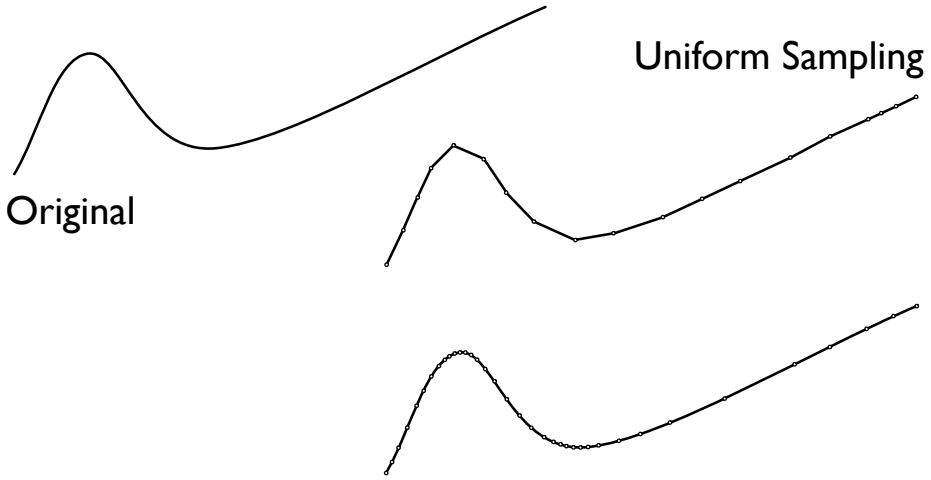
V2005-18-1.0

Today

- Tessellation
- Introduction to Animation

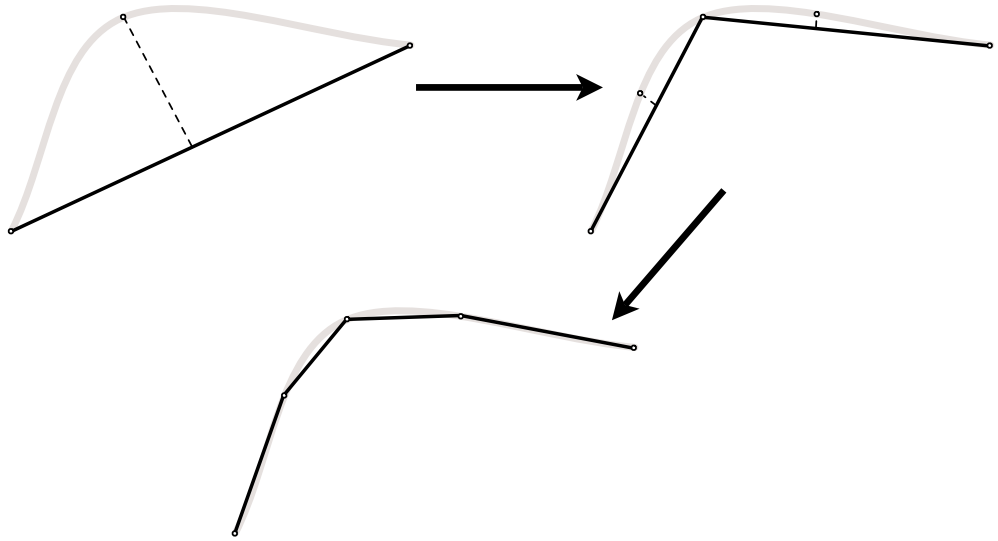
Adaptive Tessellation

- Recall early discussion of curve drawing



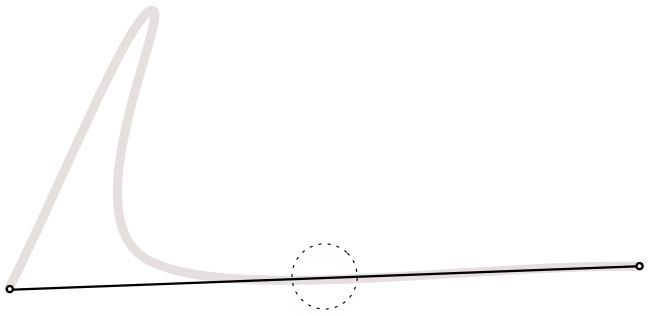
Adaptive Tessellation

- Midpoint test subdivision



Adaptive Tessellation

- Midpoint test subdivision
- Possible problem

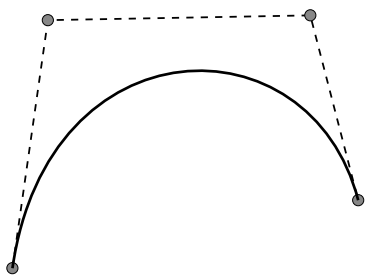


Adaptive Tessellation

- 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

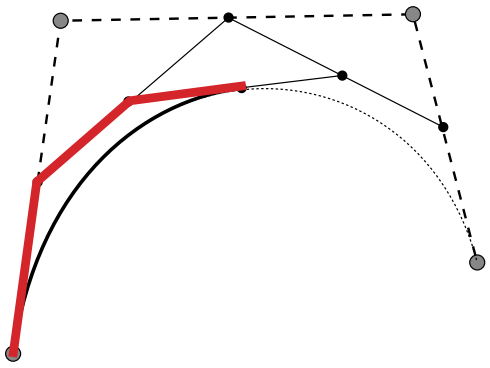


Bézier Subdivision

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

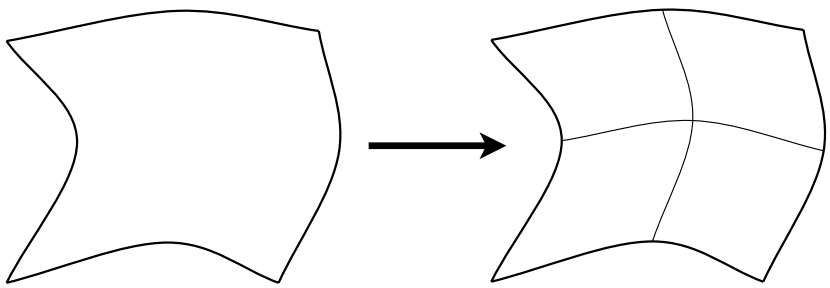
Repeated subdivision makes smaller/flatter segments

Also works for surfaces...



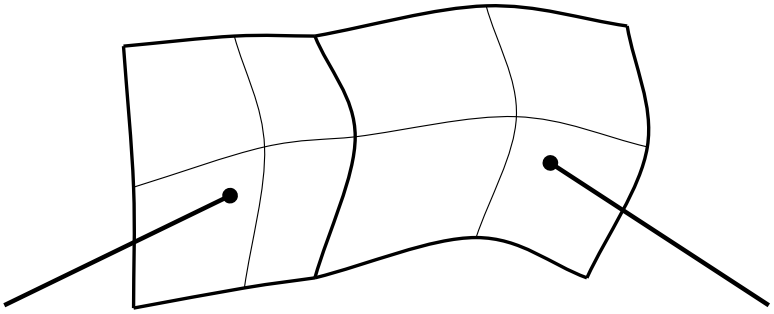
Adaptive Tessellation

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



Adaptive Tessellation

- Avoid cracking

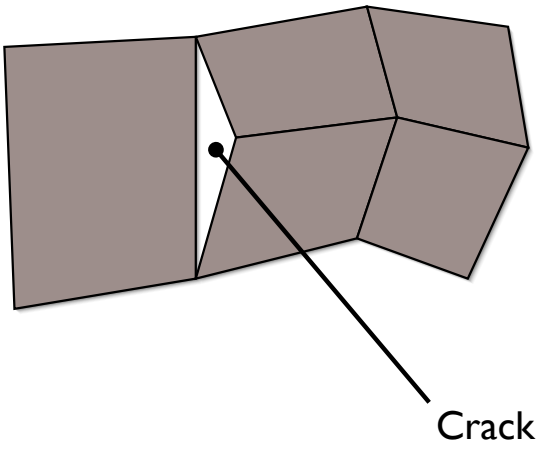


Passes flatness test

Fails flatness test

Adaptive Tessellation

- Avoid cracking

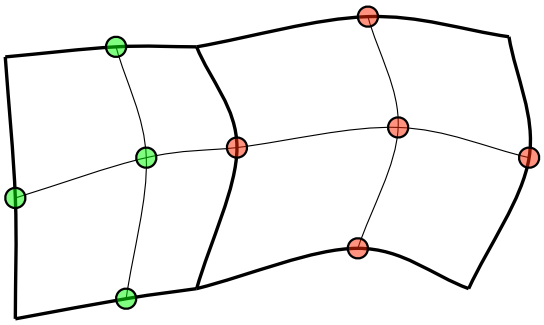


Crack in the surface

Cracks may be okay in some contexts...

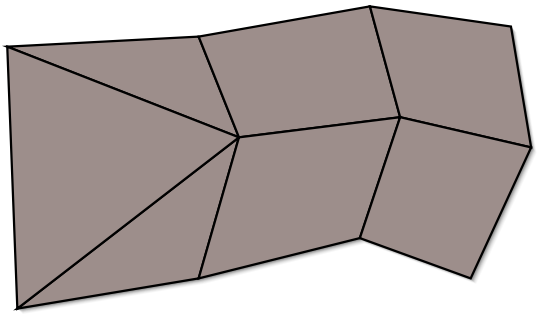
Adaptive Tessellation

- 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)

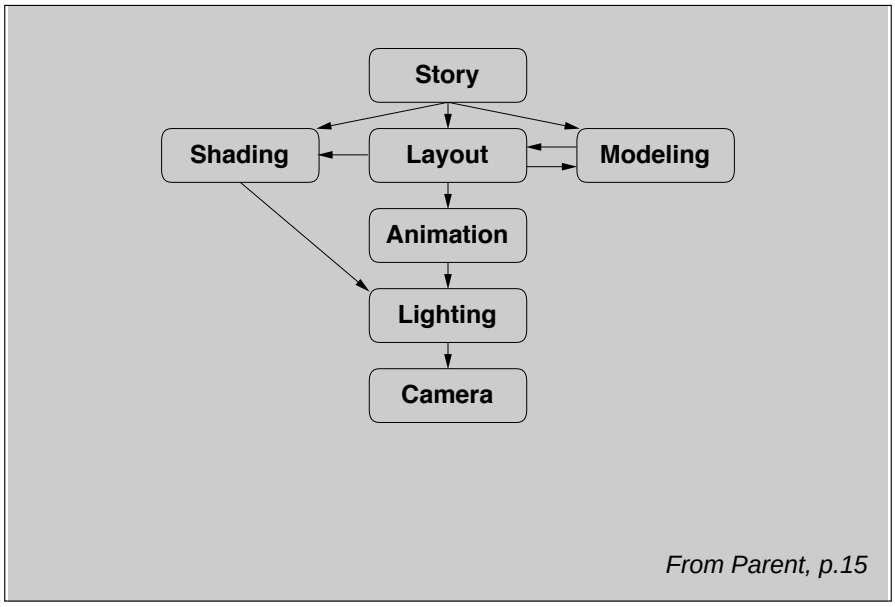
Introduction to Animation

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

Introduction to Animation

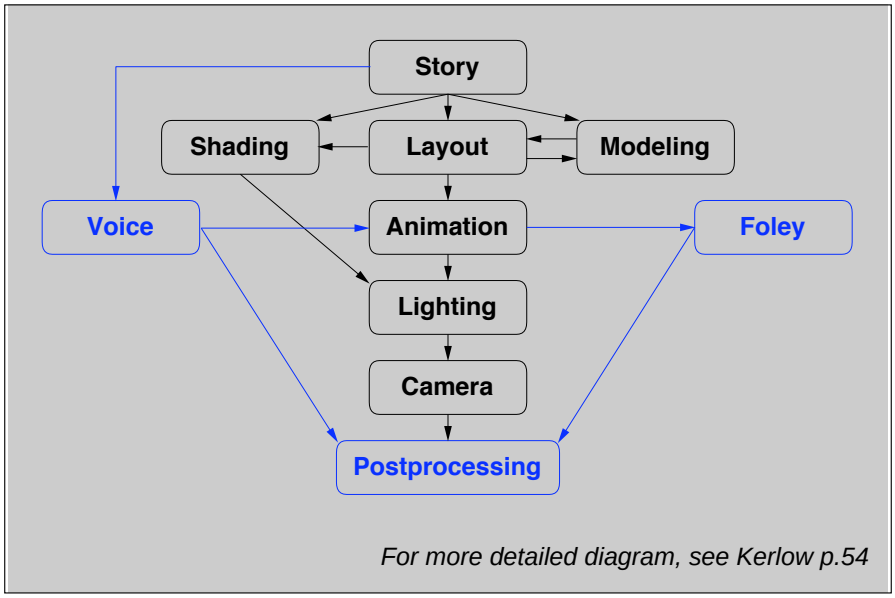
- Technical issues often dominated by aesthetic ones
- Violation of realism desirable in some contexts
- Animation is a communication tool
  - Should support desired communication
  - There should be something to communicate

Introduction to Animation



From Parent, p.15

Introduction to Animation

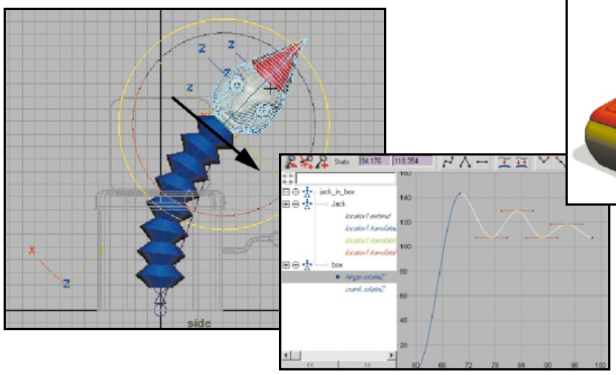


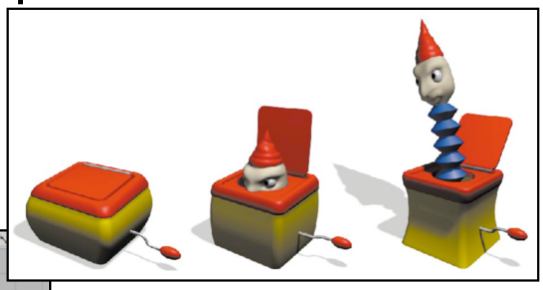
Introduction to Animation

- 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

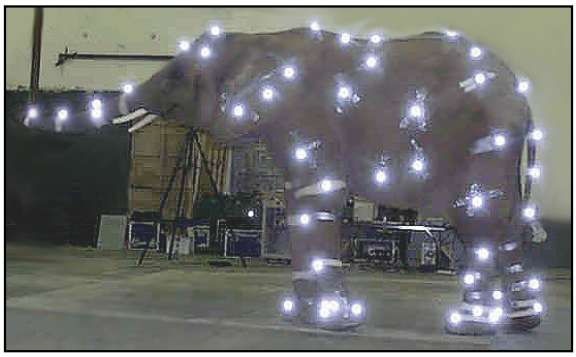




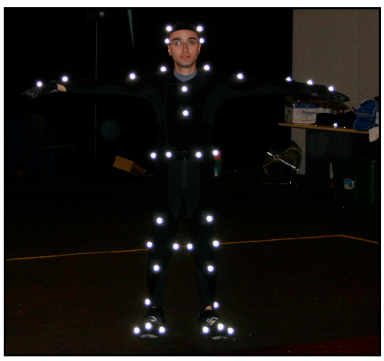
From *Learning Maya 2.0*

Motion Capture (recorded)

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

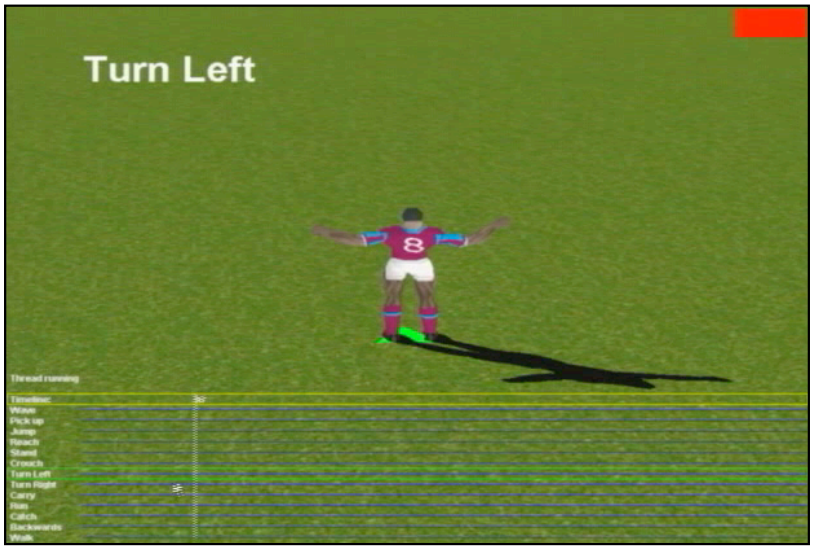


MotionAnalysis / Performance Capture Studio



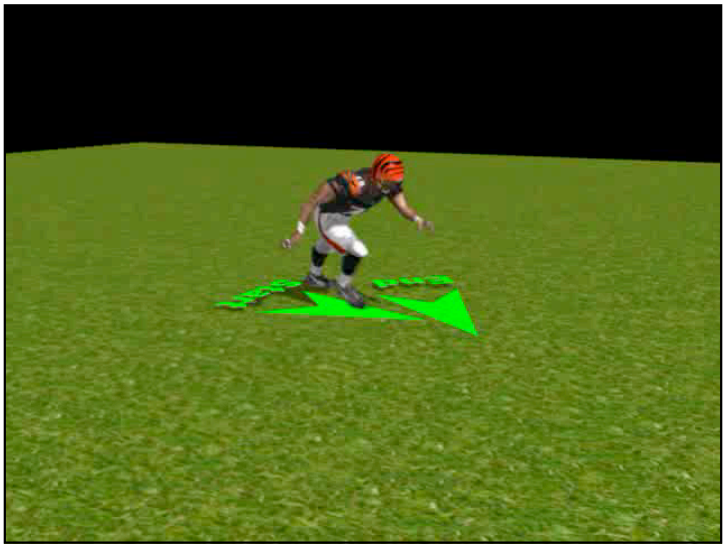
Okan Arikan

Motion Editing



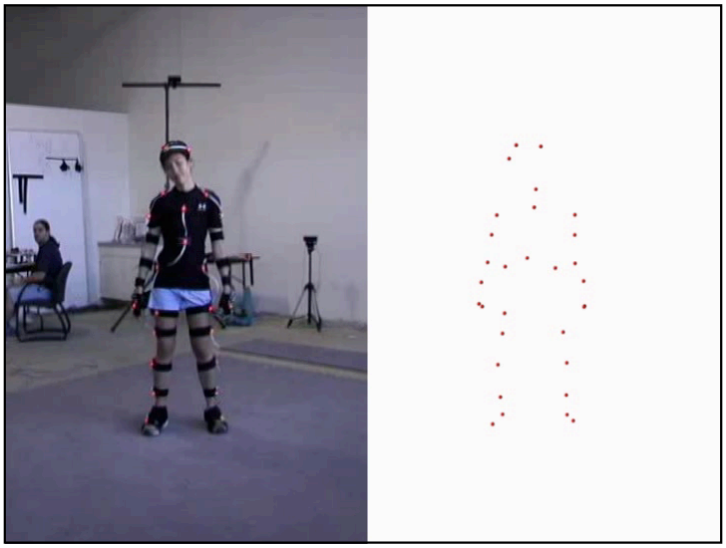
Arikan, Forsyth, O'Brien, SIGGRAPH 2002

Motion Editing



Arikan, Forsyth, O'Brien, SIGGRAPH 2002

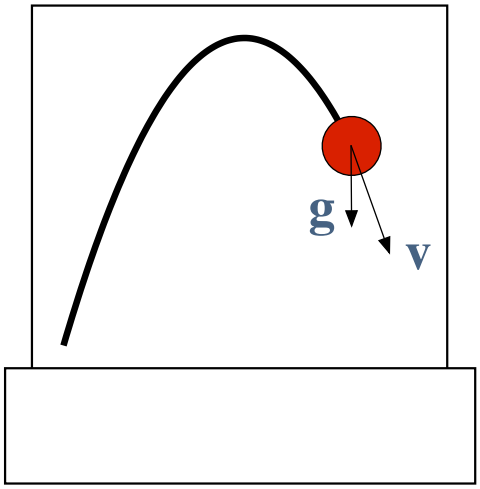
Model Construction

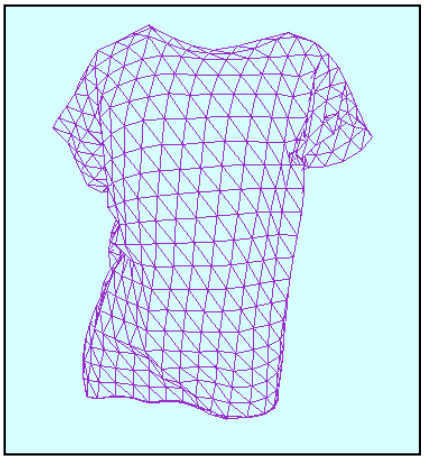


Kirk, O'Brien, Forsyth, CVPR 2005

Simulation

- Generate motion of objects using numerical simulation methods

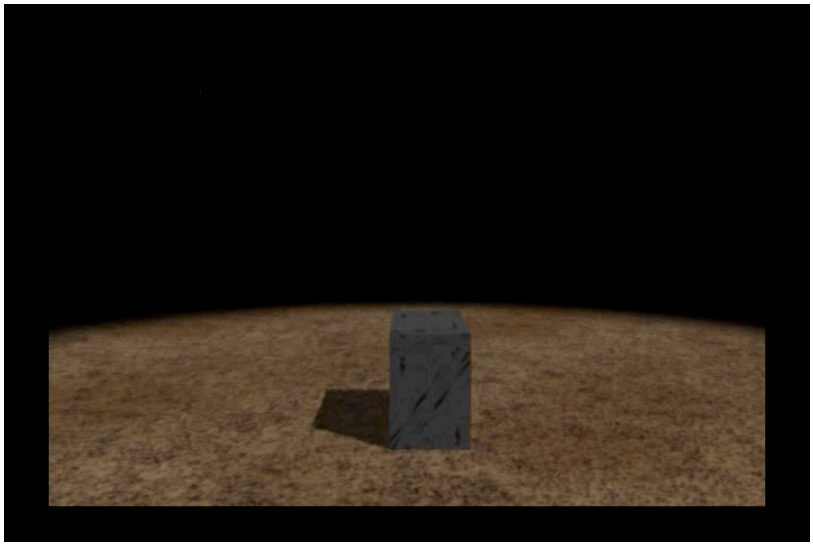




Simulation

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

Simulation



Feldman, Arikan, O'Brien, CVPR 2005

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

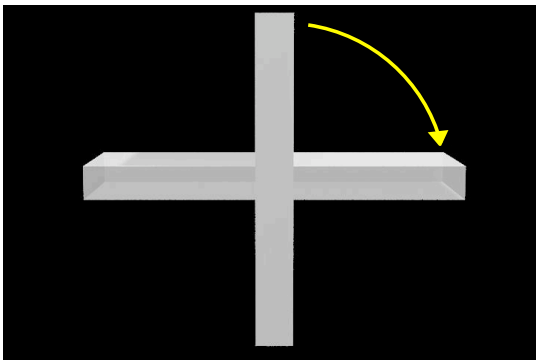
- Old way:
  - Multiple expensive tape decks
  - Slow
  - Difficult
  - Error prone
- New way:
  - Non-linear editing software
    - Premiere, Final Cut Pro, others...
  - Beware compressed solutions
  - May take a long time for final encoding

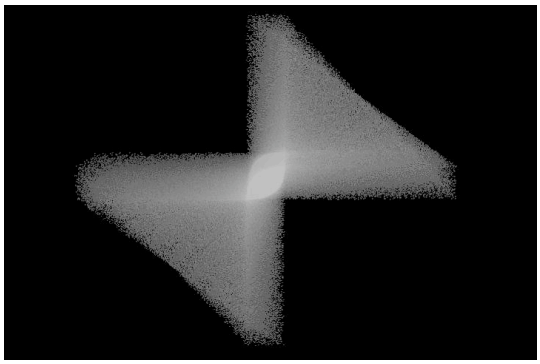
Motion Blur

- 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