

# CS-184: Computer Graphics

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Lecture #16: Introduction to Animation

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V2006-F-16-1.0

## Introduction to Animation

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- 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

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

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# Introduction to Animation

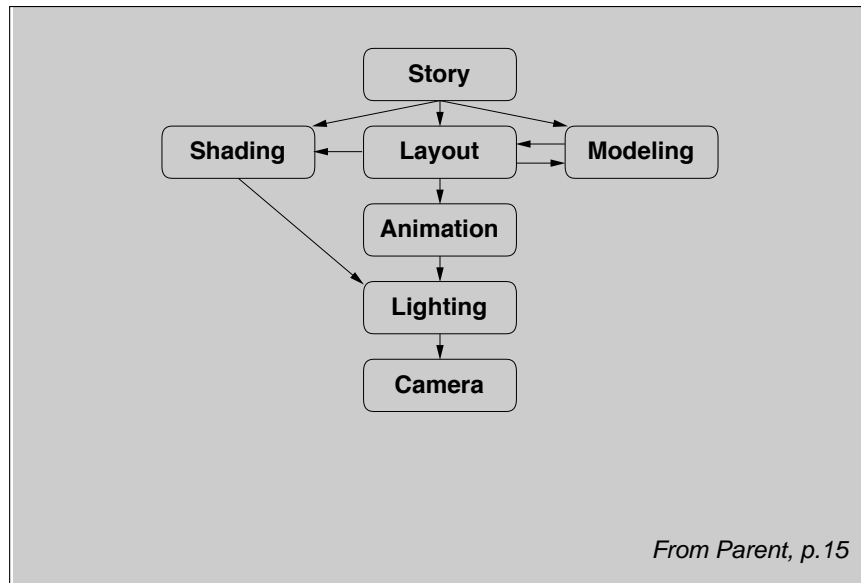
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- Technical issues often dominated by aesthetic ones
- Violation of realism desirable in some contexts
- Animation is a communication tool
  - Should support desired communication
  - There should be something to communicate

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# Introduction to Animation

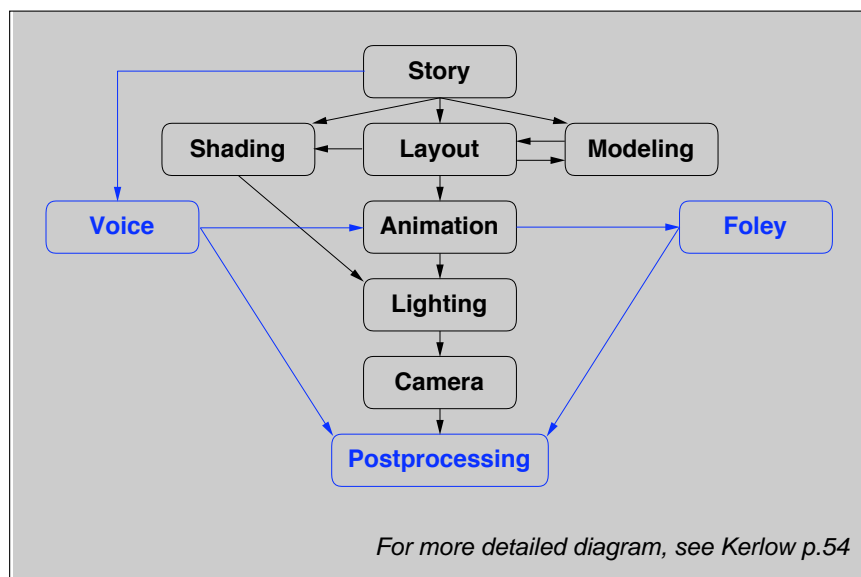
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# Introduction to Animation

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# Introduction to Animation

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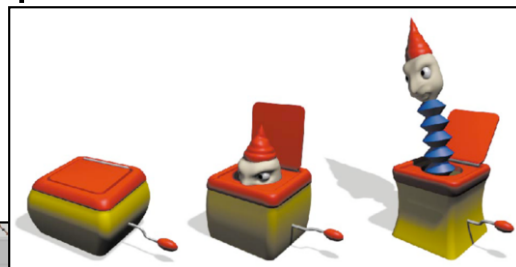
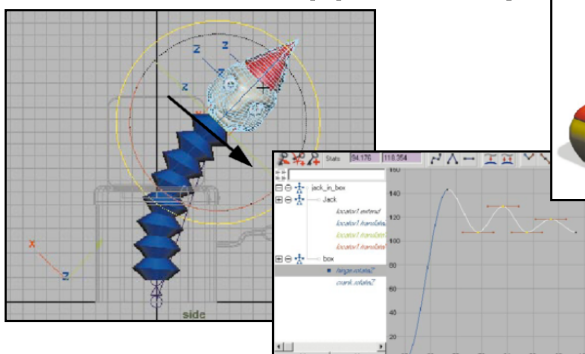
- Key-frame animation
  - Specification by hand
- Motion capture
  - Recording motion
- Procedural / simulation
  - Automatically generated
- Combinations
  - e.g. mocap + simulation

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## Key-framing (manual)

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- Requires a highly skilled user
- Poorly suited for interactive applications
- High quality / high expense
- Limited applicability



From *Learning Maya 2.0*

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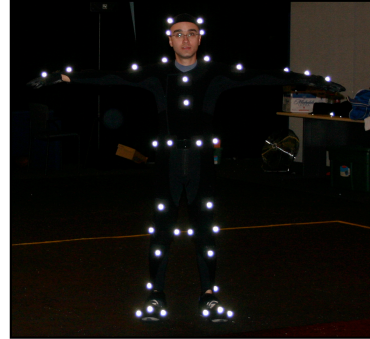
# Motion Capture (recorded)

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



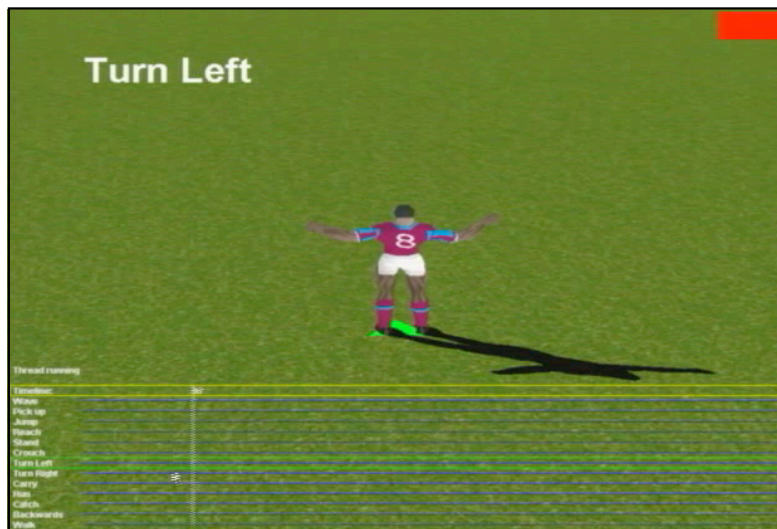
MotionAnalysis / Performance Capture Studio



Okan Arikan <sup>9</sup>

# Motion Editing

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Arkan, Forsyth, O'Brien, SIGGRAPH 2002

# Motion Editing

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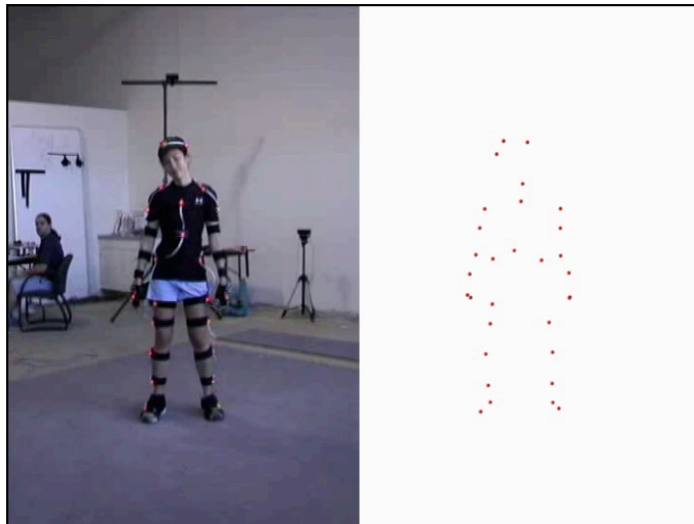


Arikan, Forsyth, O'Brien, SIGGRAPH 2002

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# Model Construction

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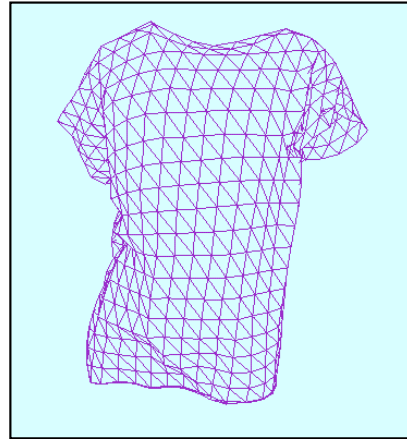
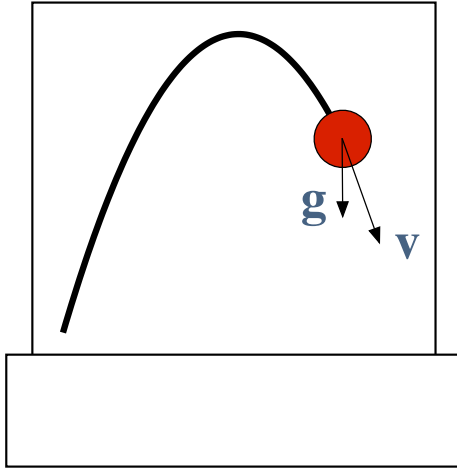
Kirk, O'Brien, Forsyth, CVPR 2005

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# Simulation

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- Generate motion of objects using numerical simulation methods



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# Simulation

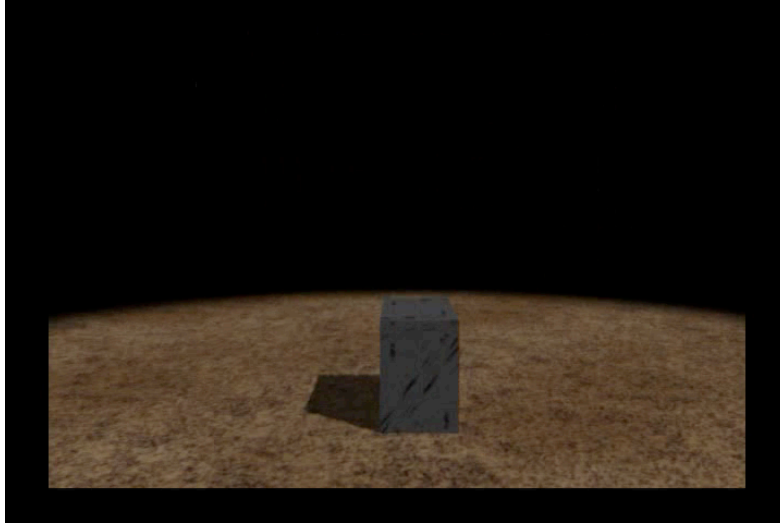
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- Perceptual accuracy required
- Stability, easy of use, speed, robustness all important
- Predictive accuracy less so
- Control desirable

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# Simulation

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Feldman, Arikian, O'Brien, CVPR 2005

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# What to do with animations?

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

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# Video Tape

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- 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)

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# NTSC Standard

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- 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

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# Digital Video

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- 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

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# Digital Video

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- 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)

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# Path to Tape

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- **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

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# Editing

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- **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

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# Motion Blur

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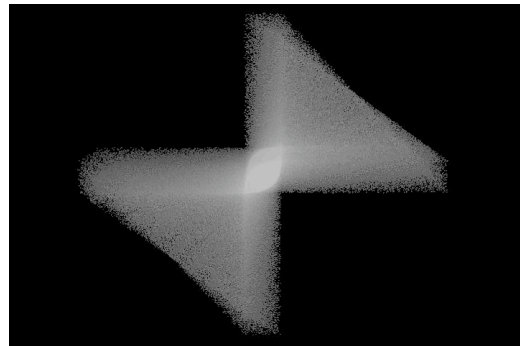
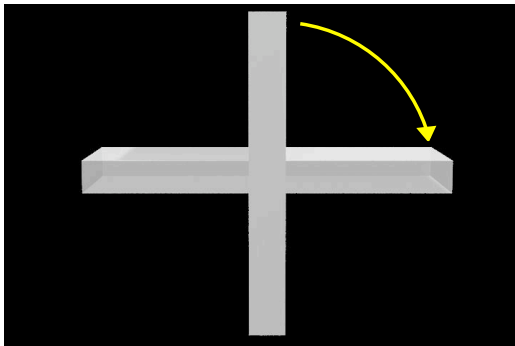
- Fast moving things look blurry
  - Human eye
  - Finite exposure time in cameras
- Without blur: strobing and aliasing
- Blur over part of frame interval
  - Measured in degrees (0..360)
  - 30 tends to often look good

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# Motion Blur

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



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# Motion Blur

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- Velocity based blur often works poorly

