Announcements

Midterms back at end of class
½ lecture and ½ demo in mocap lab

Have you started on the ray tracer?
If not, please do… due April 10th

Overview of Animation Section

- Techniques
  - Traditional animation
  - Keyframing
  - Motion Capture
  - Physically based (dynamics)

Animation—Motion Capture

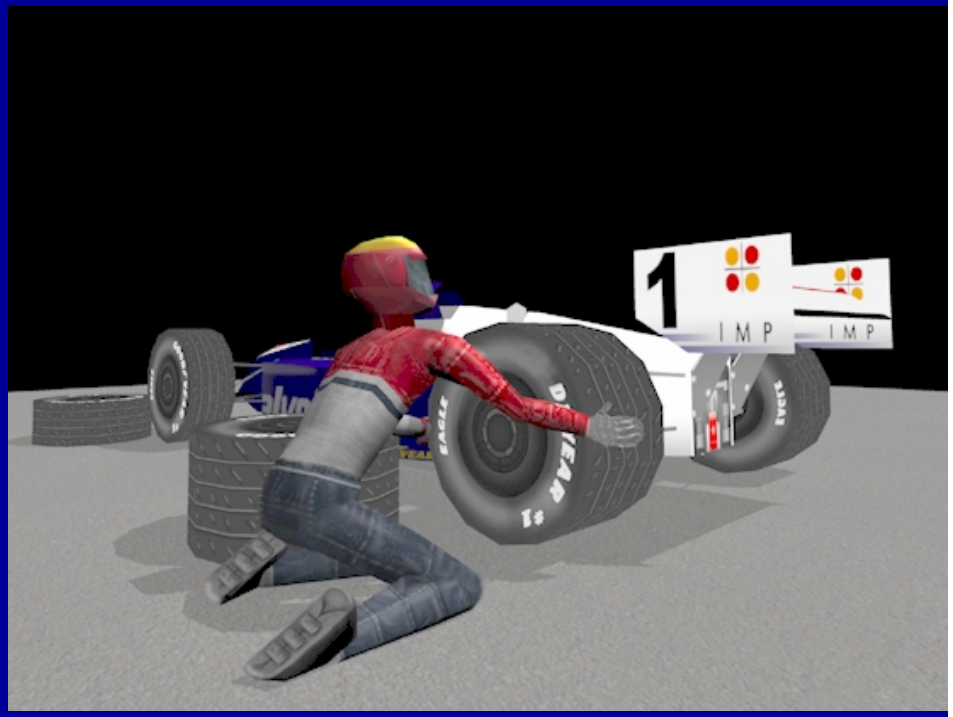
Equipment
Low-level Processing of Data
Higher-level Processing of Data

COMPUTER GRAPHICS

15-462

10/17/02

Motion Capture



Record the animation from live action

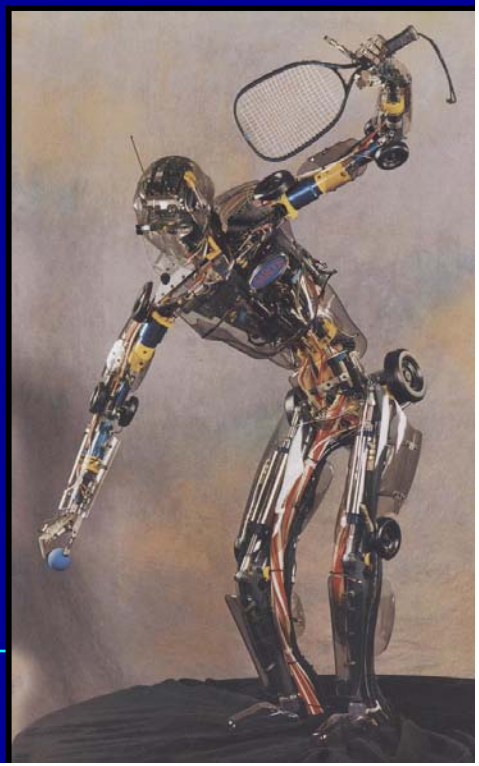
–simplest method - rotoscope over video of real motions

Real time input devices

Off-line processing of data

Motion Capture

- Animation
- Interactive characters
- Robot control



Motion Capture

Motion Capture

Record movements of actors

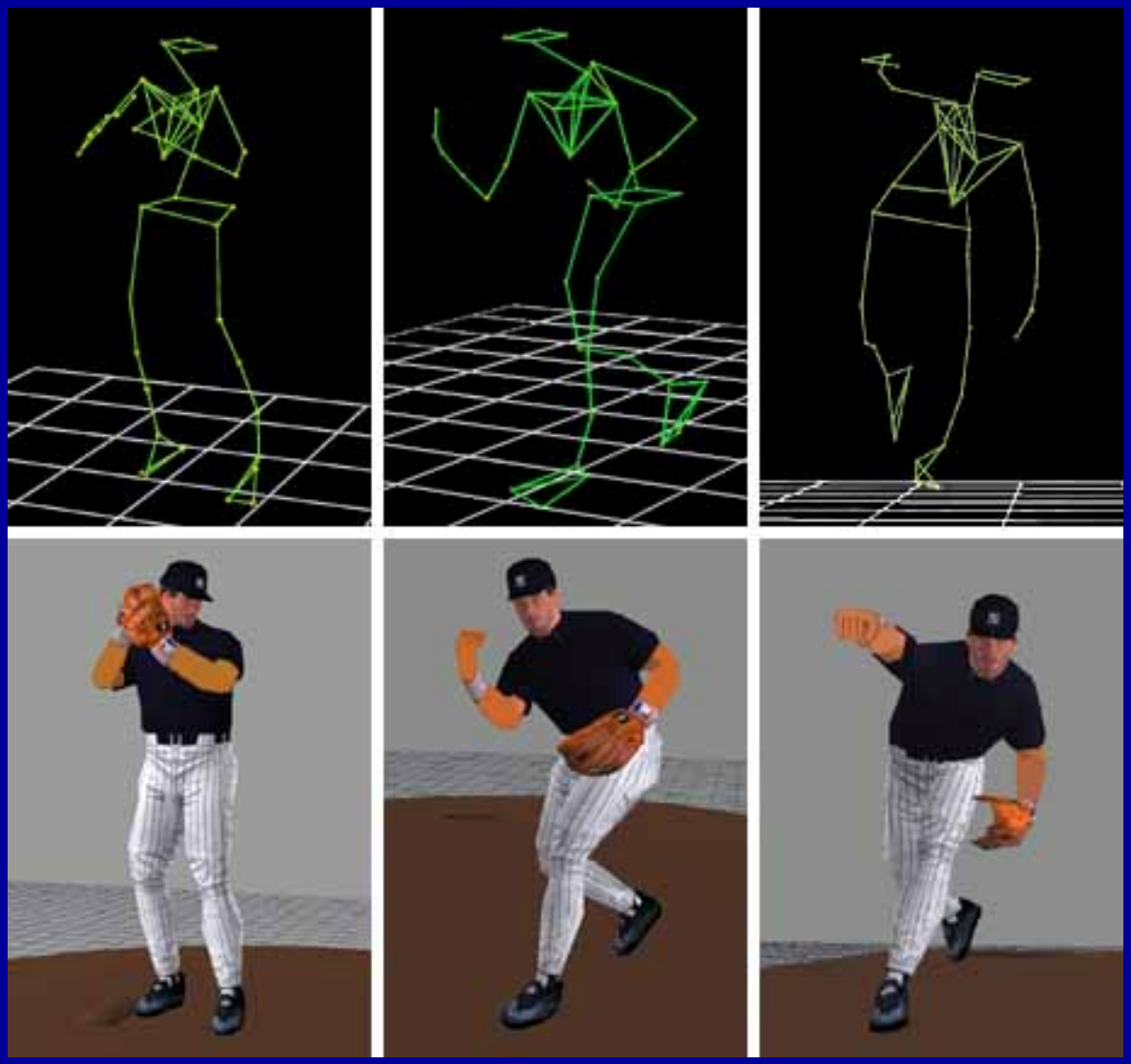
- Motion capture lab at CMU (1ST Floor of Wean):
  - Vicon M camera system, 12 cameras
  - 9mm markers

Motion Capture

Motion capture

- track motion of reference points
  - » body or face
  - » magnetic
  - » optical
  - » exoskeletons
- convert to joint angles (not so straightforward)
- use these angles to drive an articulated 3-D model
- modify the motion for the situation
- give the user control

Motion Capture

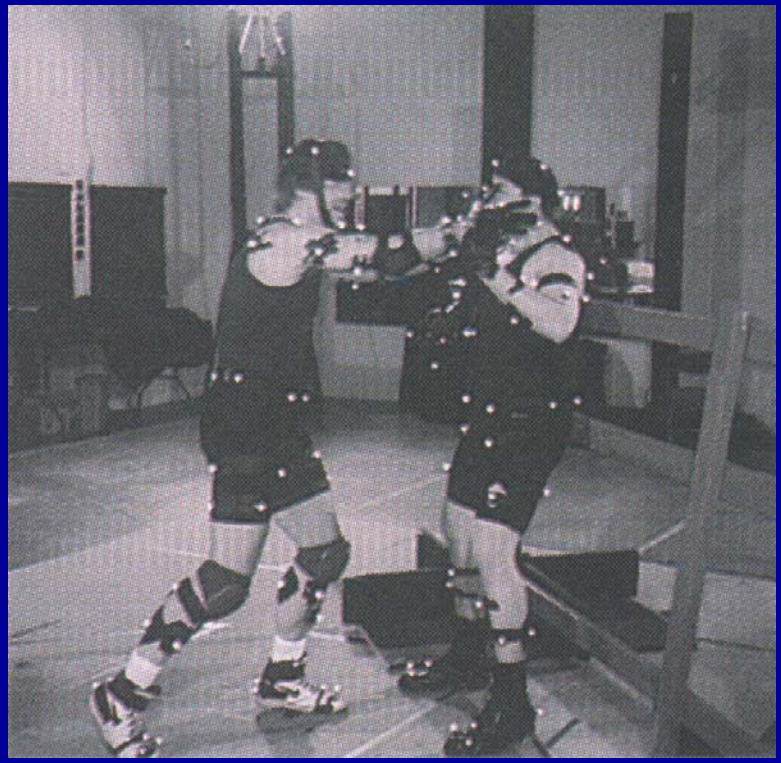


http://popularmechanics.com/technology/computers/2001/11/motion_sickness/index3.phtml

Technologies: Optical Passive

Vicon, Motion Analysis

Position of markers only



Technologies: Optical Passive

$180K

high resolution cameras

- –cameras at 120-240HZ, 1000x1000
- –IR or visible light strobe
- –6 characters with 30 markers/each

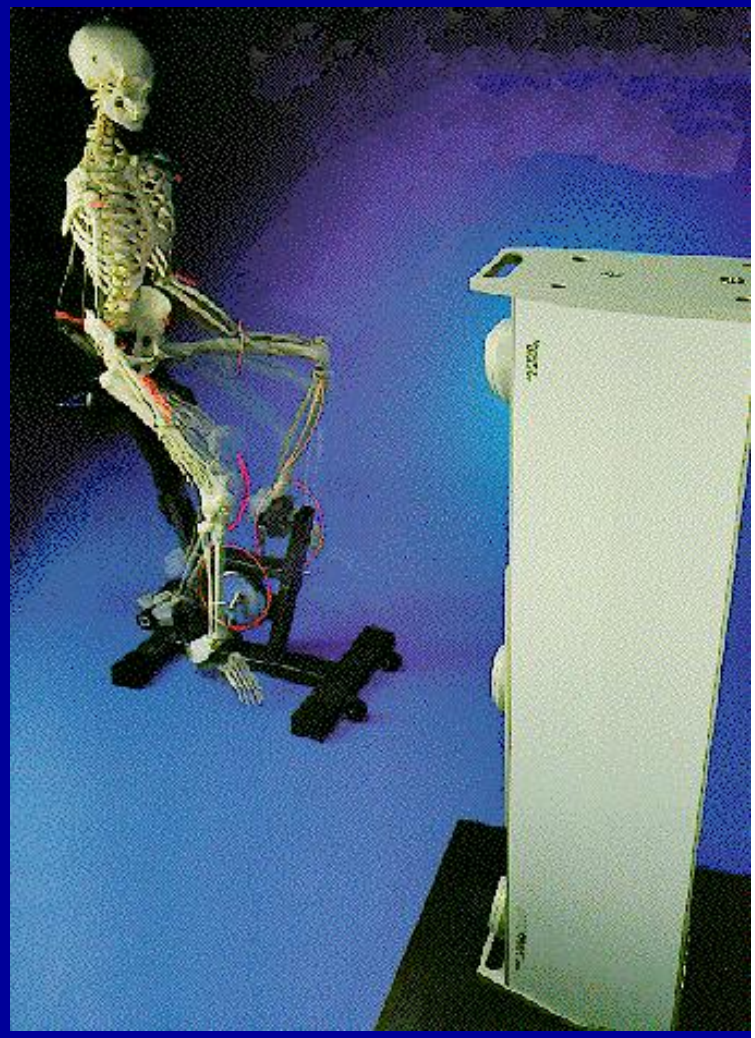
not outdoors (no sunlight)

Real time – at some cost of quality of processing

Technologies: Optical Active

Optitrak:

- ~56 markers at 100 fps
- No correspondence problem



Technologies: Optical Active

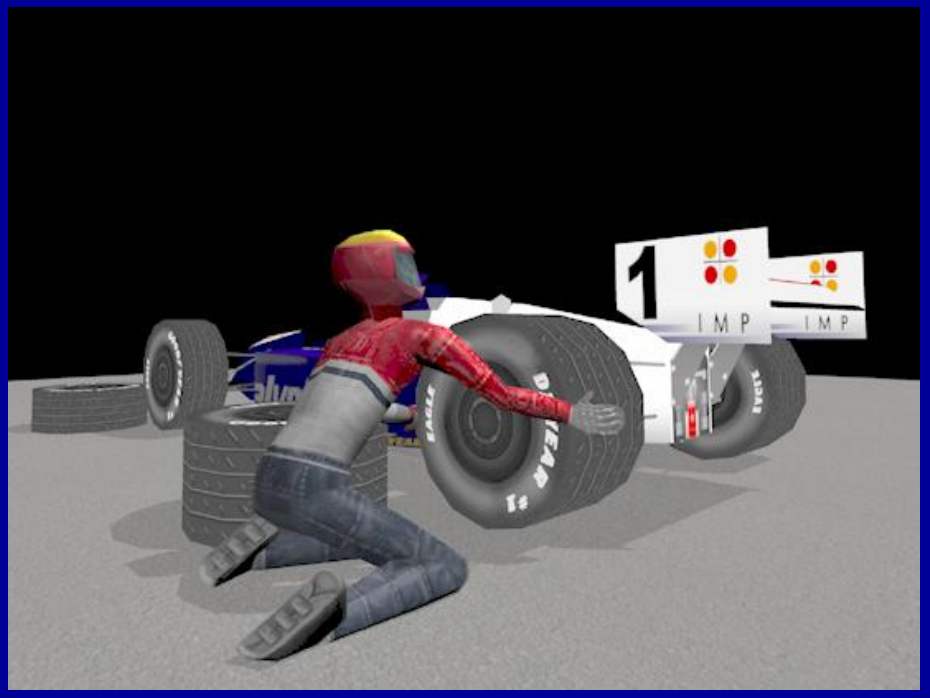
Reactor from Ascension

- 30 markers at 30 fps
- 540 sensors, flashing leds
- Correspondence automatic

Technologies: Magnetic

Ascension, Polhemus

Position and orientation



Technologies: Magnetic

heavier sensors (more flop)

wires on body (wireless back to base station)

both position and orientation information

real time

$70K ($2K/additional marker

limited accuracy (~10x less accuracy)

much smaller workspace

spikes in data -> filtering

~80 hz max

sensors are the cost and so it doesn't scale

sensitive to EMI/ metal, particularly in floor

Technologies: Exoskeleton

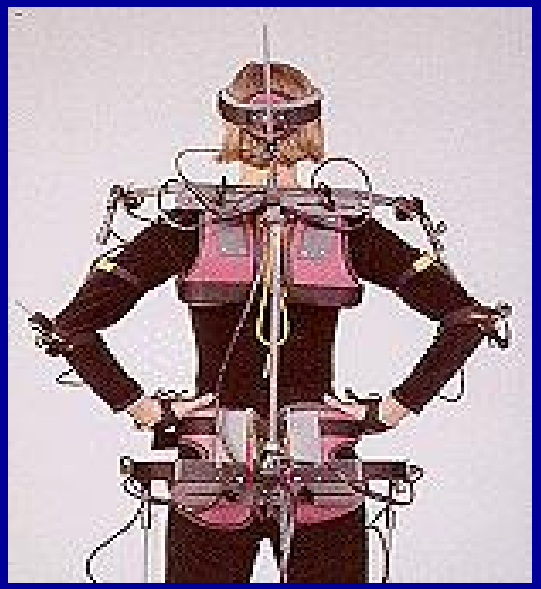
Analogous, Sarcos

restrictions of movement

assumptions of transformation to rigid body motion made at time of design of system

high frequency (500 Hz)

truly real-time



Technologies: Monkey

Puppeteering of animated characters

Exoskeleton without the person!
Or of course, the intuition about how to move…

What is captured?

dynamic or slow moving?

What is captured?

What is captured?

"rigid" body motion

flexible objects

What is captured?

Large spaces are hard

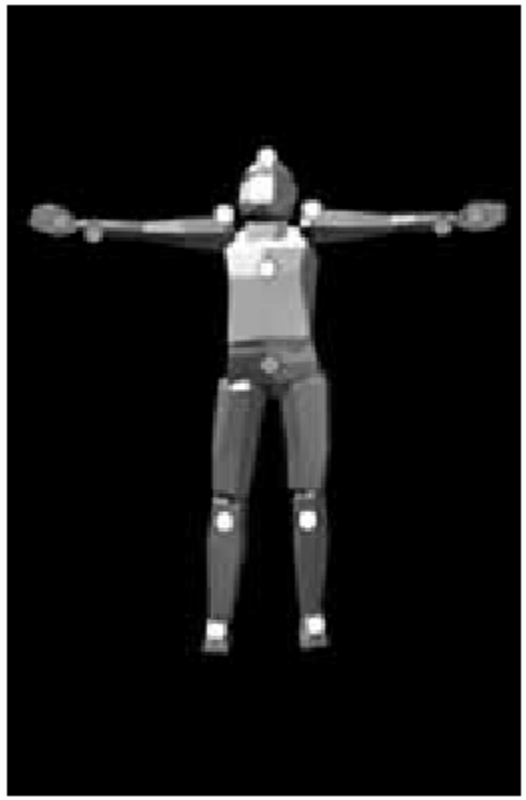
http://popularmechanics.com/technology/computers/2001/11/motion_sickness/index2.pht

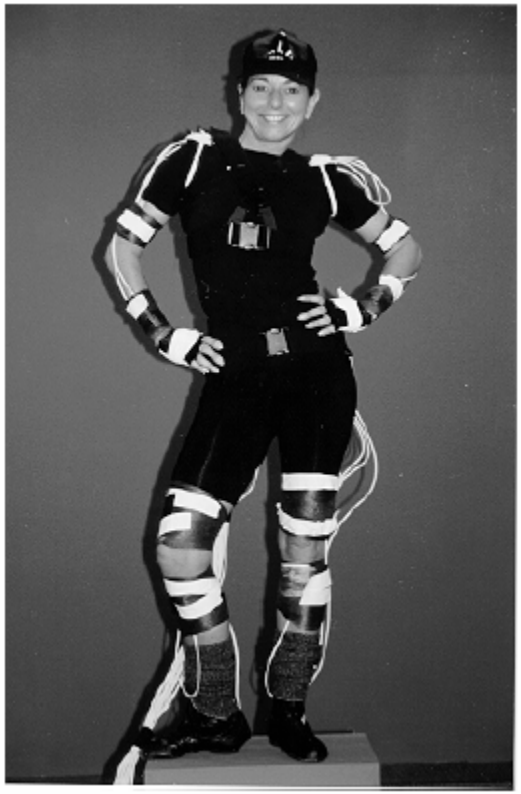
Getting from sensors to animation

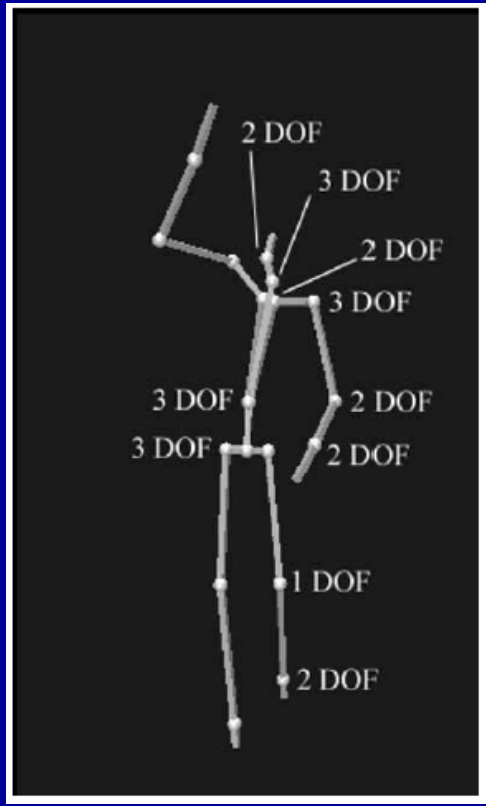
The Process of Motion Capture: Dealing with the Data

Bodenheimer, Rose, Rosenthal, Pella

http://www.vuse.vanderbilt.edu/~bobbyb/pubs/dealingdata97.pdf







Getting from sensors to animation

- Non-linear optimization to find joint angles for missing sensors
- Filtering for noise
- Feet slippage

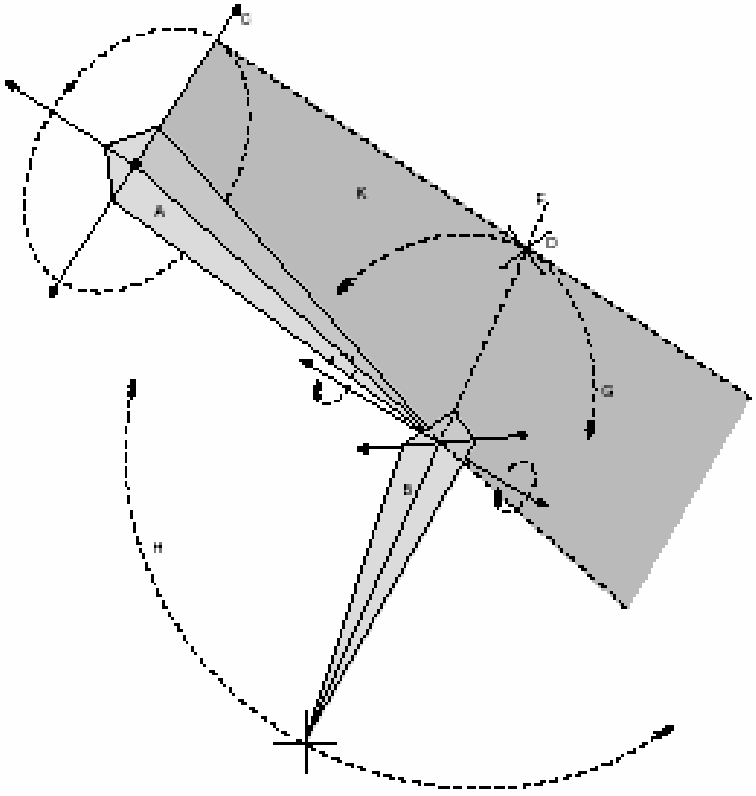


Figure 2: Upper arm model.

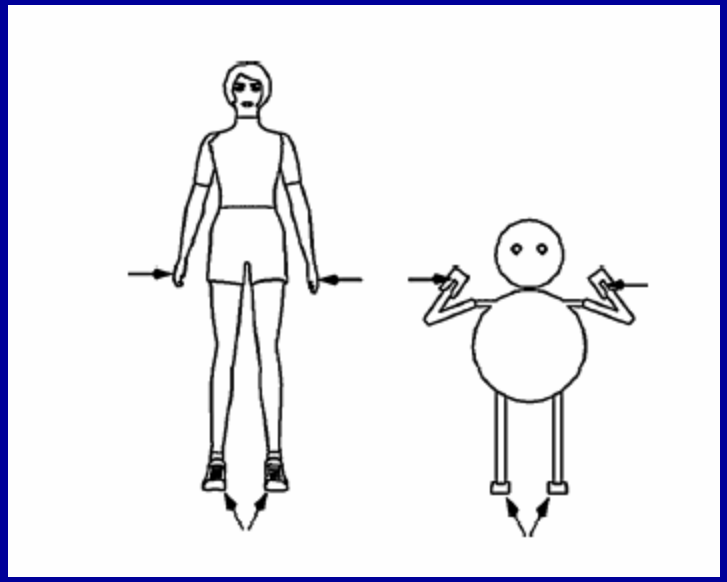
Research Issues

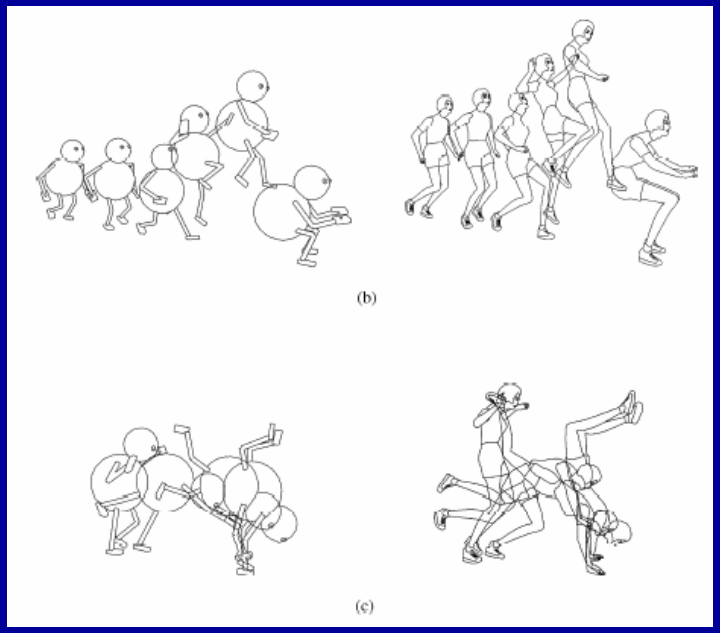
Marker placement/extraction of rigid body model via optimization

O'Brien, J. F., Bodenheimer, B. E., Brostow, G. J., Hodgins, J. K., Automatic Joint Parameter Estimation from Magnetic Motion Capture Data. Proceedings of Graphics Interface 2000, Montreal, Quebec, Canada, May 15-17, pp. 53-60.

Research Issues

- Retargeting
  - –What should be preserved about the motion?





Hyun Joon Shin, Jehee Lee, Michael Gleicher, and Sung Yong Shin. Computer Puppetry: An Importance-Based Approach. ACM Transactions of Graphics. April 2001.

Research Issues

- Retargeting

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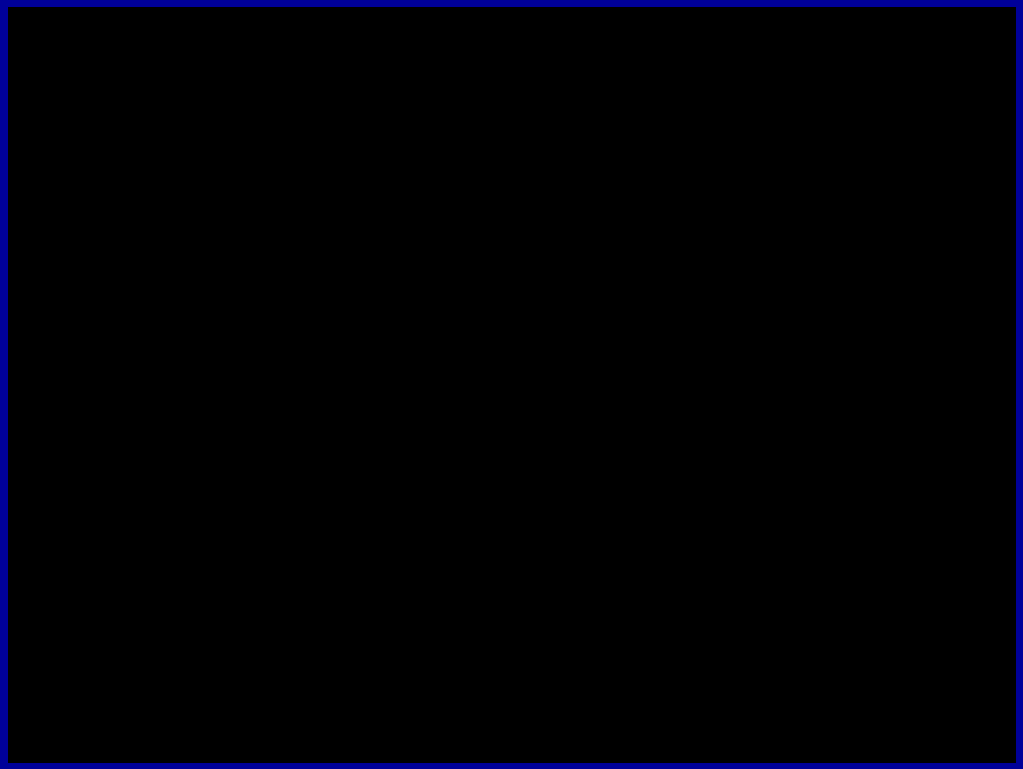
Research Issues

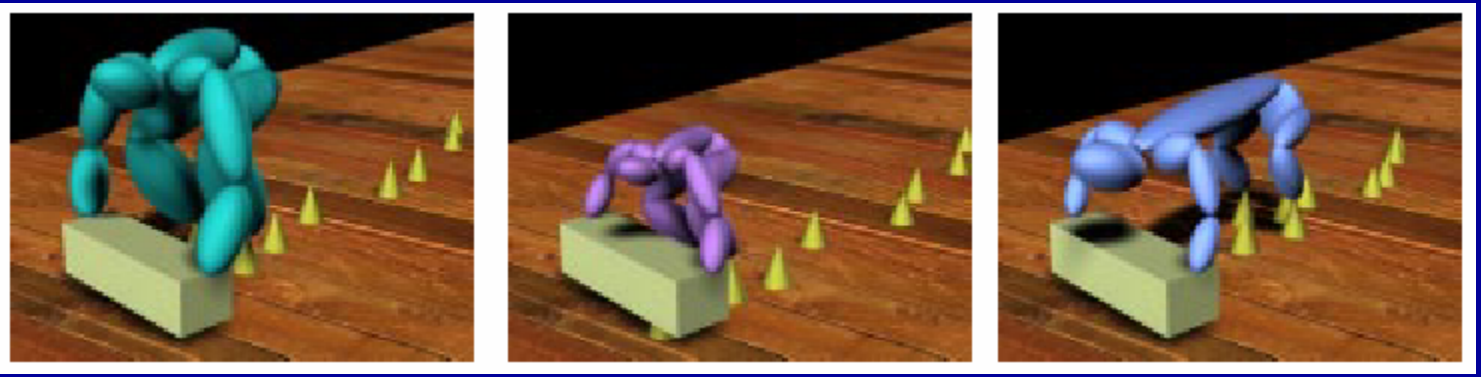
- Retargeting

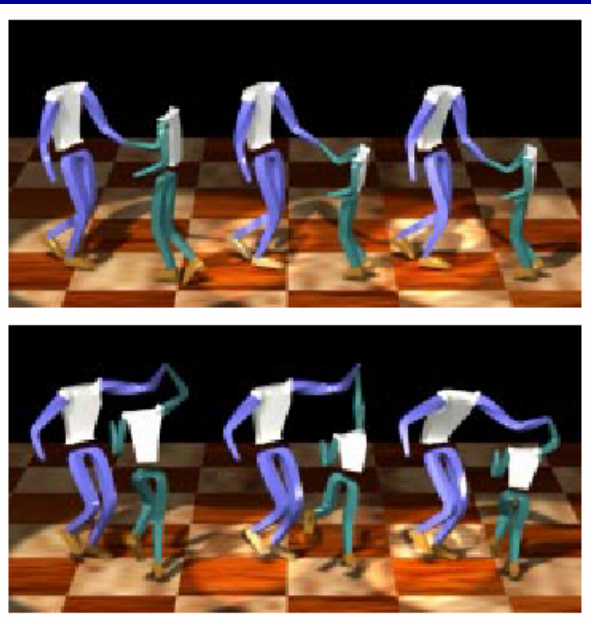


Hyun Joon Shin, Jehee Lee, Michael Gleicher, and Sung Yong Shin. Computer Puppetry: An Importance-Based Approach. ACM Transactions of Graphics. April 2001.

Research Issues

- Constraint satisfaction for editing





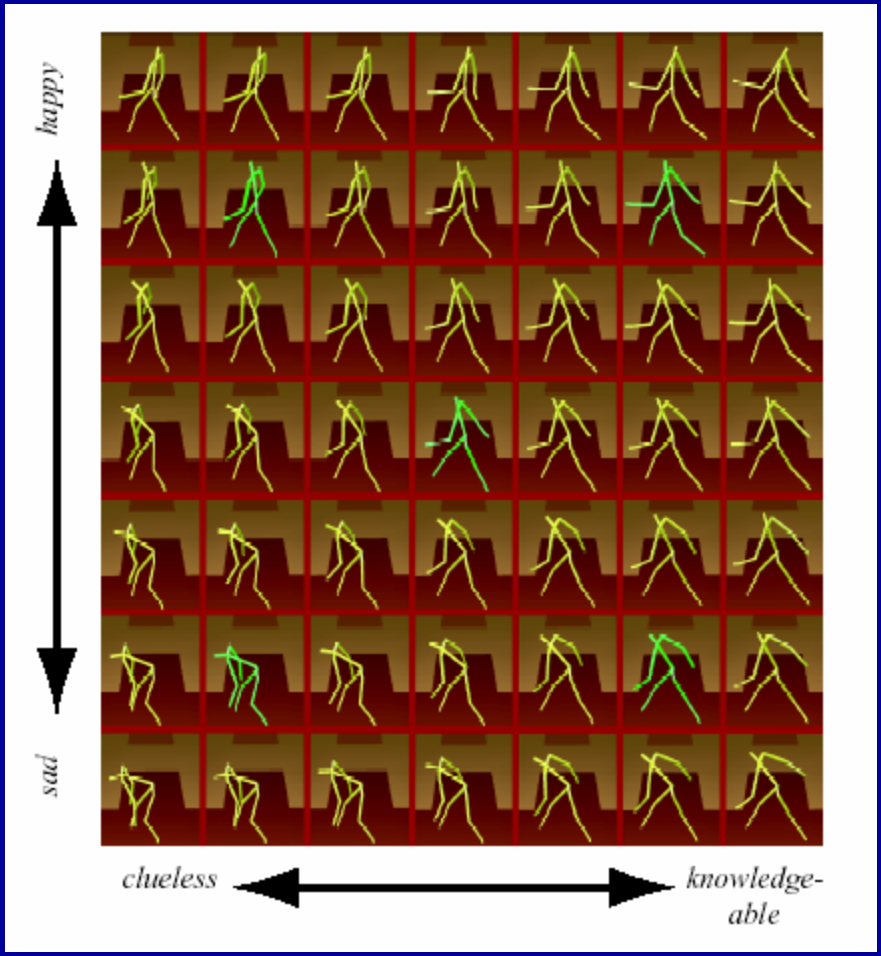
Michael Gleicher. Retargetting Motion to New Characters. Proceedings of SIGGRAPH 98. In Computer Graphics Annual Conference Series. 1998.

Research Issues

- Controlling characters

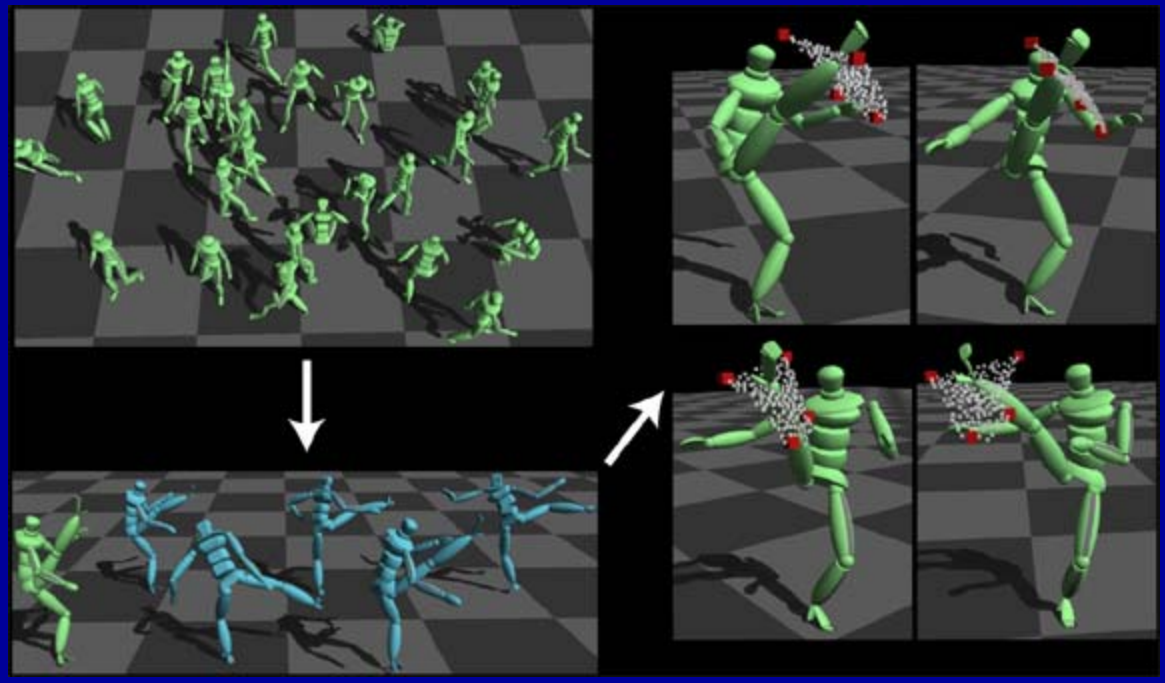
Interactive Control of Avatars Animated With Human Motion Data
Jehee Lee, Jinxiang Chai, Paul S. A. Reitsma, Jessica K. Hodgins, Nancy S. Pollard. ACM Transactions on Graphics. 21 (3). pp. 491-500. 2002.

Research Issues: Generalization of Data



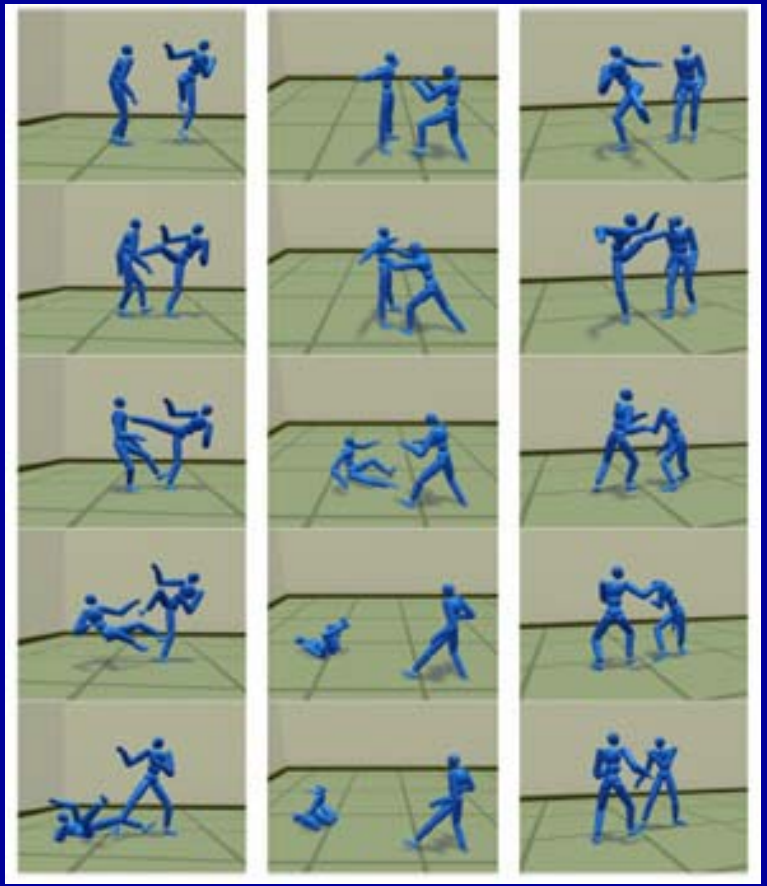
Verbs and Adverbs: multidimensional motion interpolation, Charles Rose, Michael F. Cohen, Bobby Bodenheimer, IEEE Computer Graphics and Applications , Volume: 18 Issue: 5 ,Sept.-Oct. 1998 Page(s): 32 -40

Research Issues: Interpolation for Control



Automated Extraction and Parameterization of Motions in Large Data Sets Lucas Kovar and Michael Gleicher; SIGGRAPH '04

Research Issues: Using Simulation to Generalize



Dynamic Response for Motion Capture Animation
Zordan, V. B., Majkowska, A., Chiu, B., Fast, M.
SIGGRAPH 2005.

Dynamic Skin Deformation

Sang Il Park, SIGGRAPH 2006

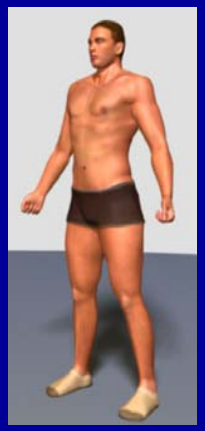
Approach

Capture session

Data cleaning

Skin animation

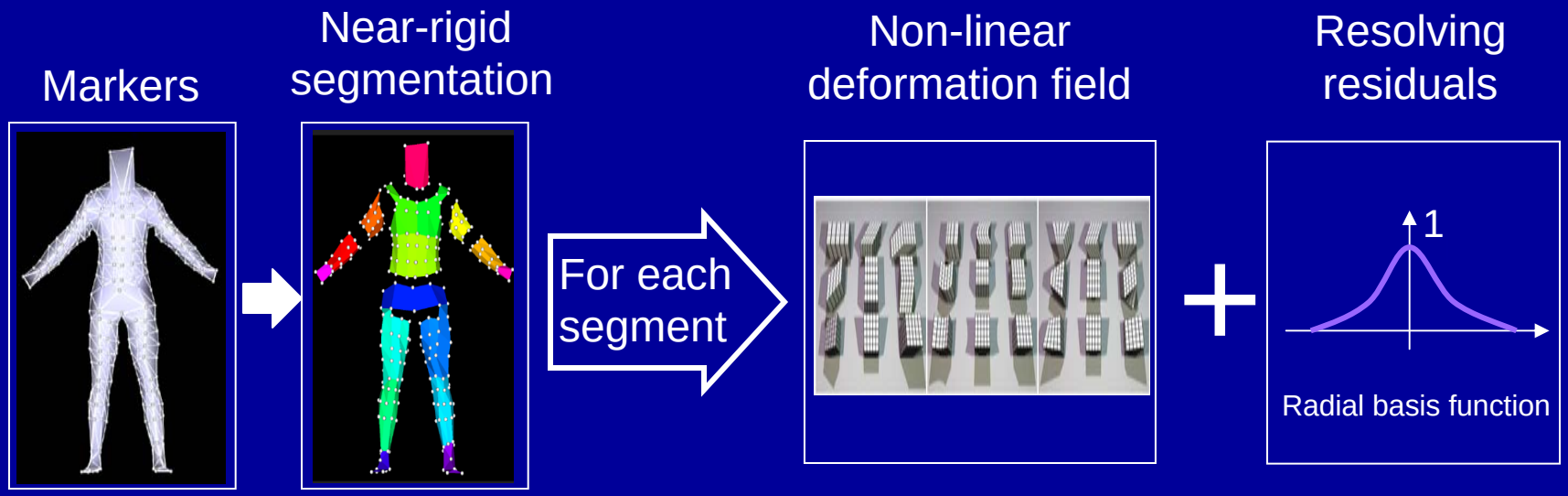
Resulting animation



Surface model in rest pose

Skin Animation

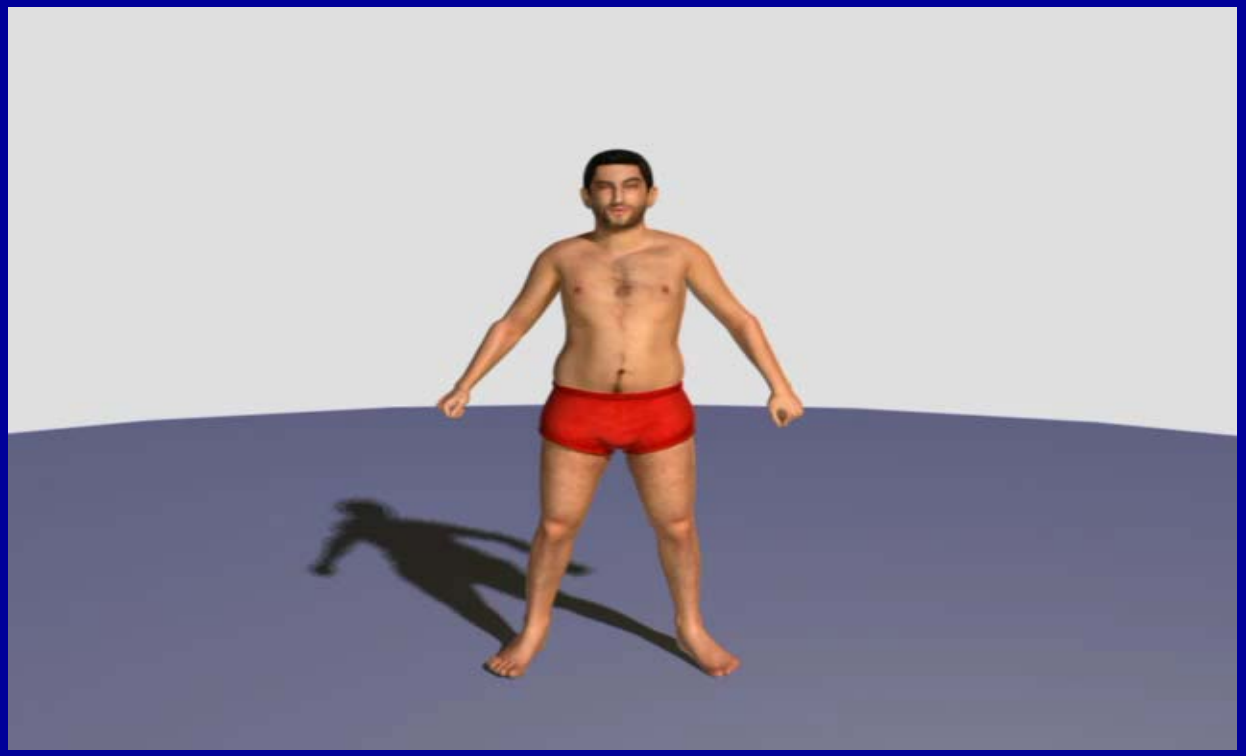
- **Subdivide the displacement vector components into rigid deformation and its local deformation**



Experimental results

Experimental results

Experimental results



Experimental results

Why is it just in sports video games?

Retargeting is hard and we don’t yet have good algorithms

Probably need to work more to keep the human in the loop.

Eric Darnell, codirector of Antz

"The main problem with motion capture associated with characters has to do with mass distribution, weight and exaggeration. He says that it is impossible for a performer to produce the kind of motion exaggeration that a cartoon character needs, and the mass and weight of the performer almost never looks good when applied to a character of different proportions."

Richard Chuang, VP at PDI

"The mapping of human motion to a character with non-human proportions doesn't work, because the most important things you get out of motion capture are the weight shifts and the subtleties and that balancing act of the human body. If the proportions change, you throw all that out the door, so you might as well animate it."

Godzilla: Karen Goulekas

"The reason that we pulled the plug on using the motion capture was, very simply, because the motion we captured from the human actor could not give us the lizard-like motion we were seeking. The mocap could also not reflect the huge mass of Godzilla either. During our keyframe tests, we found that the Godzilla motion we wanted was one that maintained the sense of huge mass and weight, while still moving in graceful and agile manner. No human actor could give us this result."

But what about Happy Feet?

Trailer

Announcements

Midterms back at end of class
½ lecture and ½ demo in mocap lab

Have you started on the ray tracer?
If not, please do… due April 10th