Motion Capture (Mocap)
What is motion capture?

- Recording 3D live action
  - whole body
  - face
  - hands
  - animals
- One way of using physical device to control animation
  - puppeteering
Pros and Cons of Motion Capture

- **Pros**
  - All fine details of human motion will be recorded --if they can be captured

- **Cons**
  - Not so easy to
    - Edit
    - Generalize
    - Control
  - Not cheap
Applications

- Animation
- Special effects
- Interactive characters
- Robot control
Computer Puppetry

Shin et al., “Computer puppetry”
Motion Capture

- track motion of reference points
- convert to joint angles to drive an articulated 3D model
- or drive a deformable surface
What is captured?

- **What do we need to know?**
  - X,Y,Z
  - roll, pitch, yaw

- **Errors cause**
  - Joints to come apart
  - Links to grow/shrink
  - Bad contact points
What is captured?

- Large and small scale

Motion Analysis
How to use the data?

- Off-line
  - Processed by filtering, inverse kinematics
  - Produce libraries of motion trajectories
    - Choose among them
    - Blend between them
    - Modify on the fly

- On-line (performance animation)
  - Driving character directly based on what actor does in real time
History of the technology

- Recording motion for biomechanics
  - High accuracy
  - Fewer recorded points
  - Hand digitizing film
  - Supplement with force plate, muscle activity
- Computer animation
  - Rotoscopying
- VR tracking technology
  - Less accuracy required
  - Fewer sensors
Production Pipeline

1. calibration
2. capture
3. Skeleton estimation
4. Inverse Kinematics processing
Optical Motion Capture (Passive)

- Passive reflection
  - Camera
    - Infrared, visible, or near infrared strobes
    - High resolution (1 to 4 million pixels)
    - 120-240 frames/sec (max 2000 frames/sec)
  - Not outdoors
  - No glossy or reflective materials
  - Tight clothing
  - Occlusion of markers by limbs or props
Optical Motion Capture in Games
Optical Motion Capture (Active)

- Active output of the LED
- No marker confusion problem
- Outdoor capture
- 3,600 x 3,600 resolution
- 120 frames/sec (128 markers or four persons)
- 480 frames/sec (32 markers or single person)
- 1/3 the cost of passive systems
Magnetic Motion Capture

- Electromechanical transducer
- Heavier sensors
- Wires on body (wireless back to base station)
- Limited accuracy (~10x less accuracy than optical)
Magnetic Motion Capture (cont.)

- Smaller workspace
- Sensors are the cost
- Sensitive to EMI/metal
- Relatively cheaper than optical device

Ascension MotionStar Wireless
**Mechanical Motion Capture**

- Subject wears an exoskeleton
- No interference from light or magnetic field
- No marker confusions
- No range limit
- Some restriction of movement
- Absolute position is unknown
Mechanical Motion Capture

- Data glove
  - Bend sensor + optical tracking
  - 6 DOF
- video

http://www.vrealities.com/glove.html
Technology Issues

- Resolution/range of motion
- Calibration
- Accuracy
  - Marker movement
  - Sensor noise
  - Restrictions on the environment
  - Capture rate
- Occlusion/correspondence
Skin Motion Capture
Park & Hodgins, SIGGRAPH’06

- Use a conventional optical motion capture system
Skin Motion Capture

- Use a conventional optical motion capture system

A dense set of markers
Skin Motion Capture

- Use a conventional optical motion capture system

A dense set of markers
Skin Motion Capture

- Use a conventional optical motion capture system

- A dense set of markers

- Detailed surface model
Skin Motion Capture

- Use a conventional optical motion capture system

Data collection and cleaning

A dense set of markers

Detailed surface model
Skin Motion Capture

- Use a conventional optical motion capture system

Data collection and cleaning

Skin Animation

A dense set of markers

Detailed surface model
Videos

- Park & Jessica, SIGGRAPH’06
- Lord of the rings: Gollum