What is Motion Capture?

capture of motion of (human) actor
> **whole body**
> **upper body**
> **face**

more generally...

**one way of using a physical device
to control animation**

> **puppeteering**
> **exoskeletons**
> **discrete sensors on actors**

Applications

movies
tv shows
video games
performance animation

Motion Capture

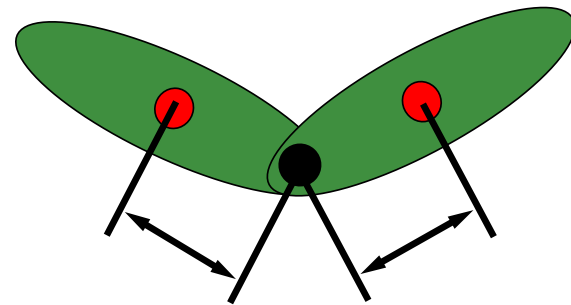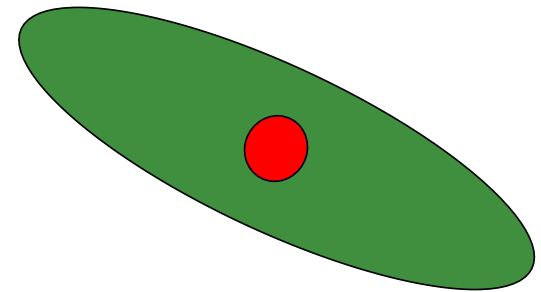**What do we need to know?**

x, y, z
pitch, roll, yaw

Errors cause

joints to come apart

links to grow/shrink

bad contact points

Sampling Rate and Accuracy

How to use the data?

off–line

    filtering, IK

    libraries of motion trajectories

        choose among them

        switch between them

        modify

on–line

    driving character directly based on what actor does in real time

History

recording motion for biomechanics
    high accuracy
    fewer recorded points
    hand digitizing film
    supplement with force plate, foot switches

robot measurements
    Selspot LED system

VR tracking technology
    less accuracy
    fewer sensors
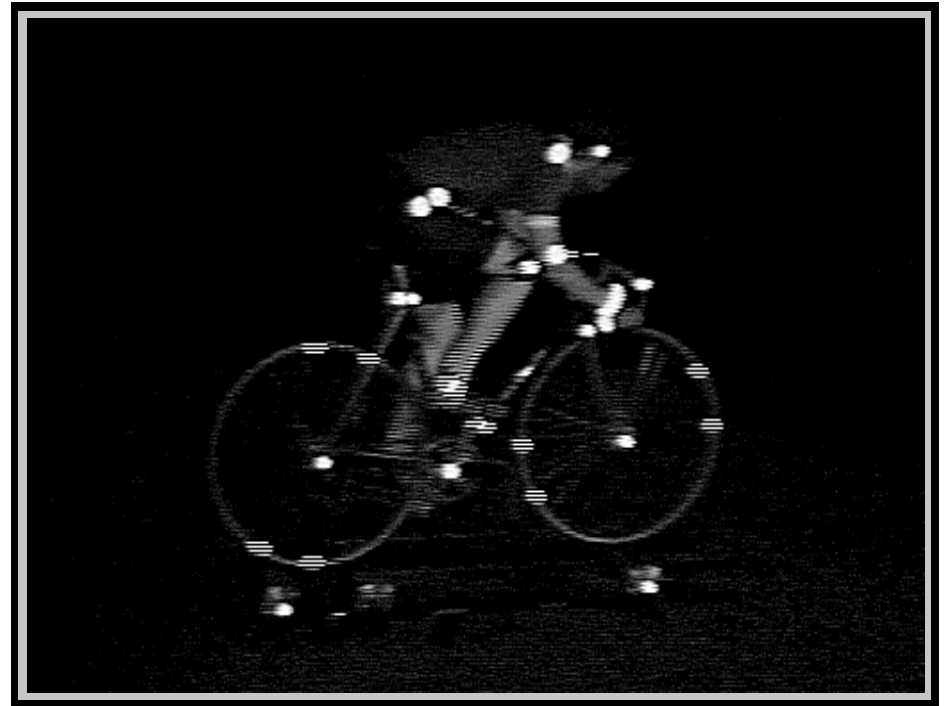
Technology--optical

passive reflection--Peak

hand or semi--automatically digitized
time consuming

no glossy or reflective materials
tight clothing
occlusion of markers by props or limbs
higher frames/second

Technology––optical

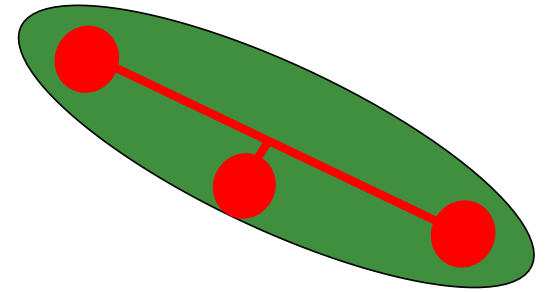**passive reflection––Acclaim, Motion Analysis,...**
automatically digitized
240 Hz
not real–time
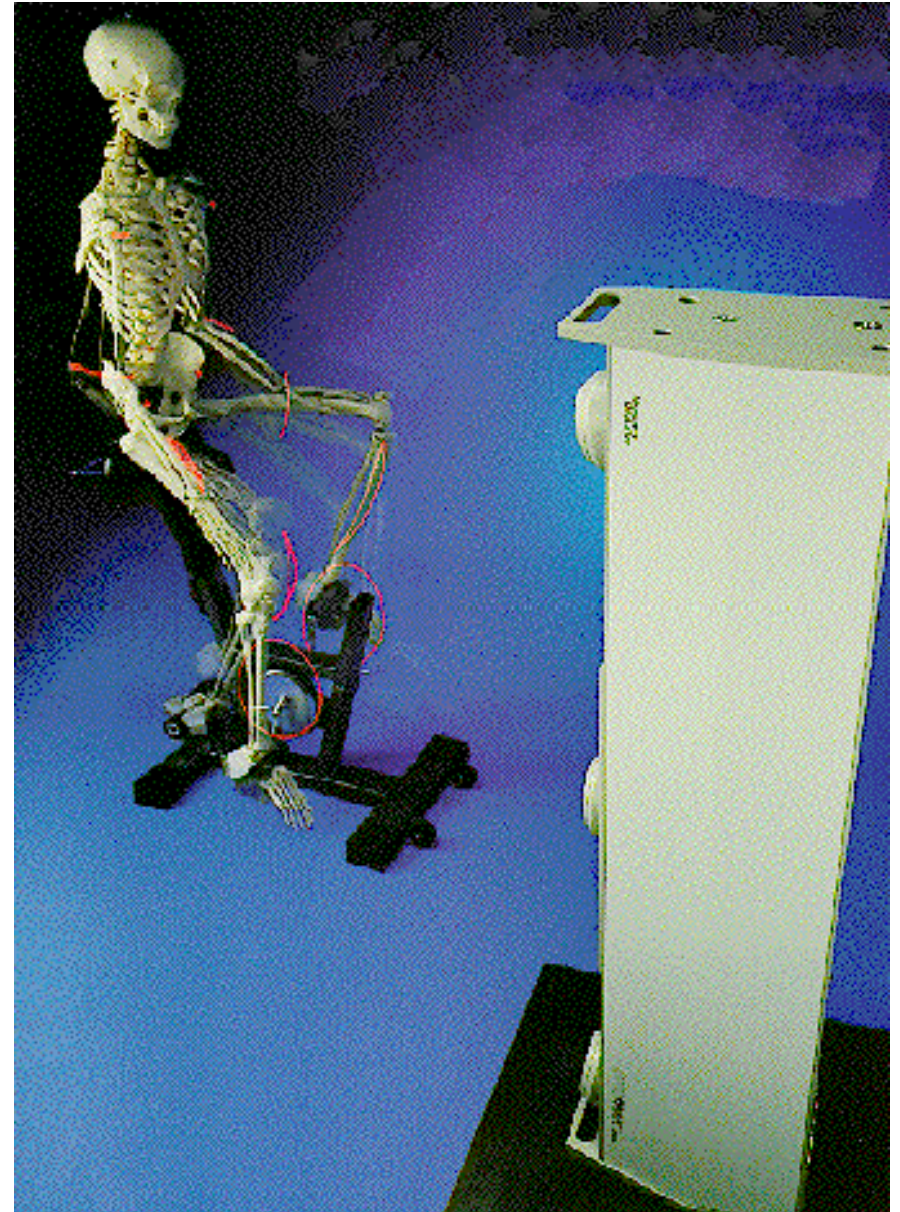3 markers/body part for 6 dof
2+ cameras for 3d position data
~$100K

Technology––optical

active light sources –– Optotrak

**automatically digitized
correspondence
256 markers
3,500 markers/second**

Technology––magnetic

electromechanical transducers
Ascension flock of birds
Polhemus Fastrak

limited range/resolution
pigtail (new wireless system)
metal in the environment
(treadmill, rebar!)
no identification problem
6 dof information
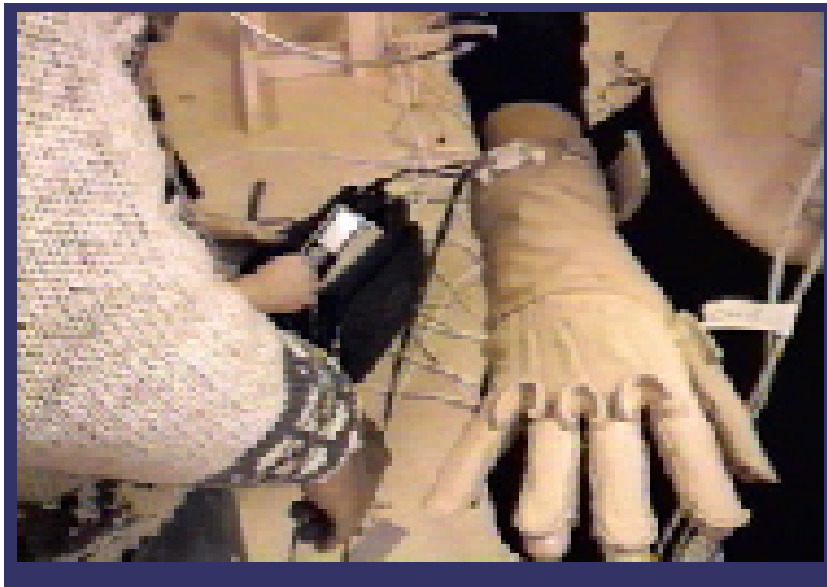realtime
low frequency: 30 to 120 Hz
few markers: 10–20
$40K

Technology––mechanical

mechanical motion capture

dataglove

low accuracy
focused resolution
recognize gestures

monkey

high accuracy
high data rate
not realistic motion
hire animator

Technology––mechanical

exoskeleton + angle sensors
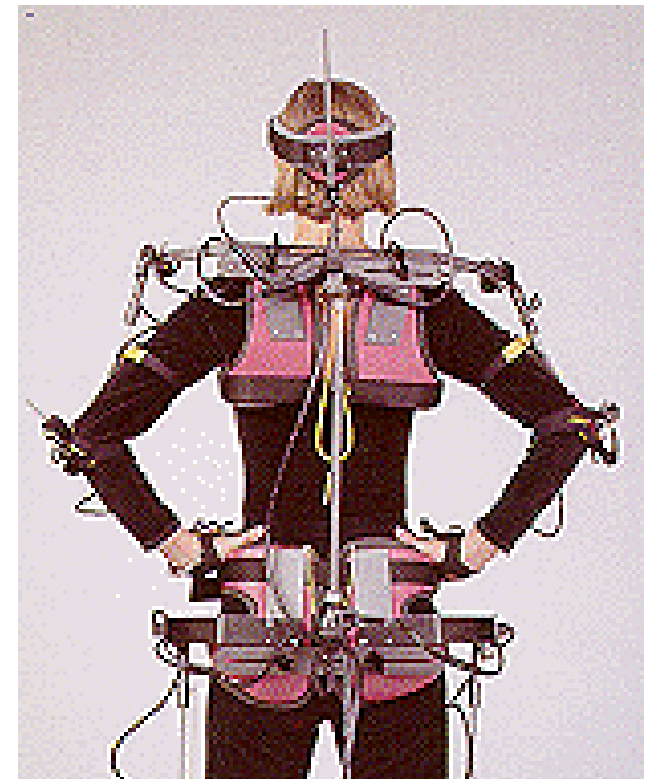### Analogous

pigtail
no identification problem
realtime
high frequency: 500Hz
not range limited
fit
rigid body approximation

Technology Issues:

resolution/range of motion

calibration

accuracy

marker movement/placement
sensor noise
skew in measurement time

restrictions on the environment
occlusion/correspondence

Technology Issues:

resolution/range of motion

calibration

accuracy

      marker movement
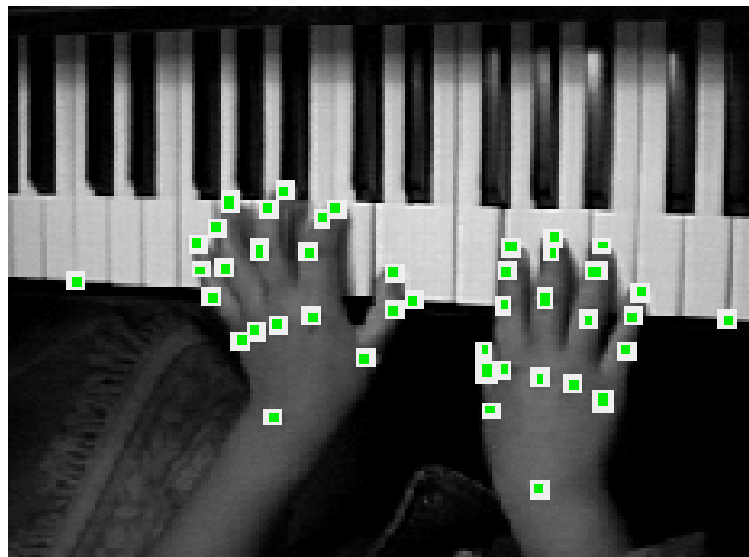   sensor noise
      skew in measurement time
      restrictions on the environment
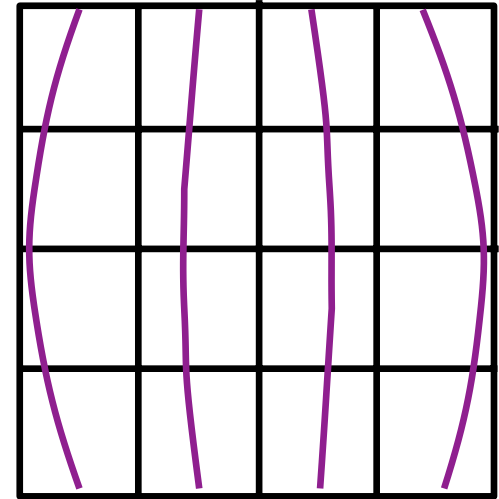   frame rate

occlusion/correspondence

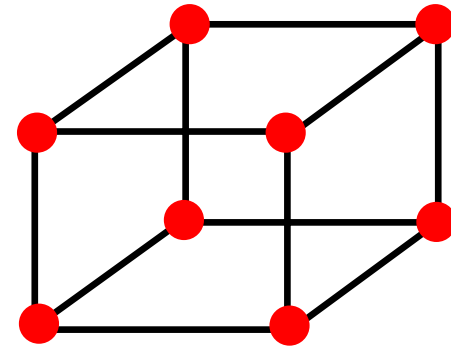# Resolution

positioning of camera

Calibration

internal camera parameters

optical distortion of lens

external parameters

position and orientation

correlation between multiple cameras

Marker Placement
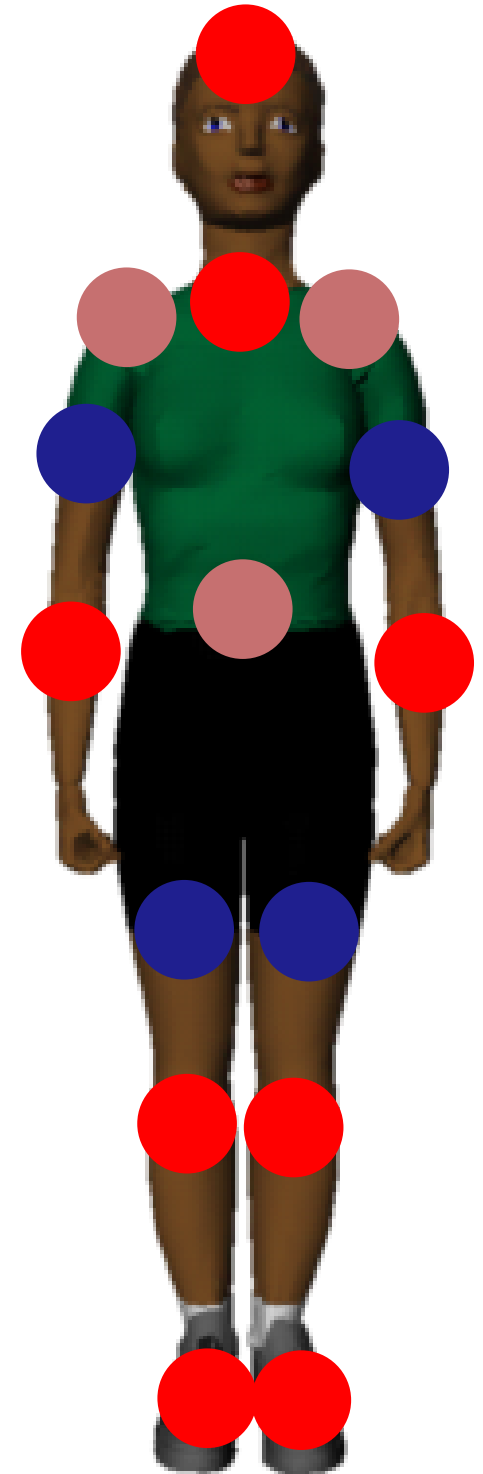
location should move rigidly with joint

stay away from bulging muscles

shoulders: skeletal motion not closely tied to motion on skin

Calibration

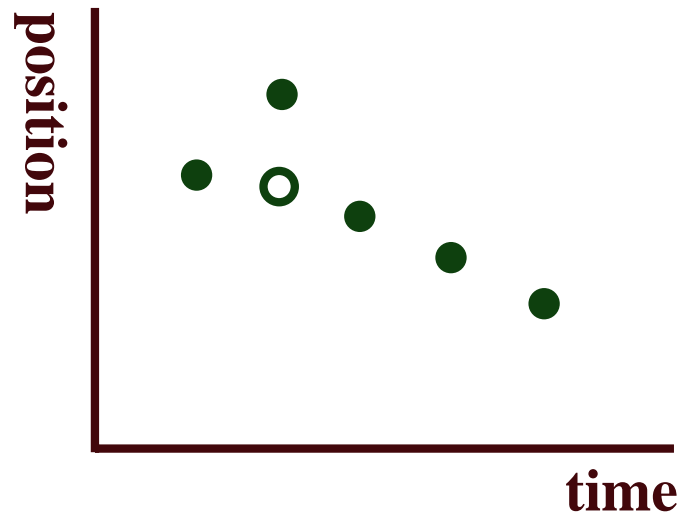zero position
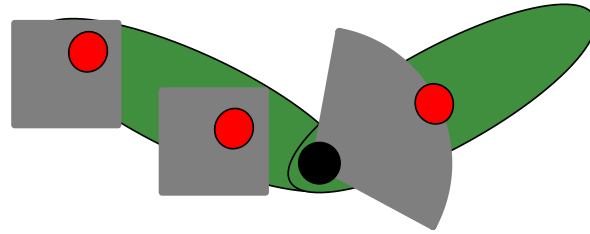fine calibration by hand

Accuracy

marker movement
sensor noise
skew in measurement time

filtering (requires high data rate)

Model–based Techniques

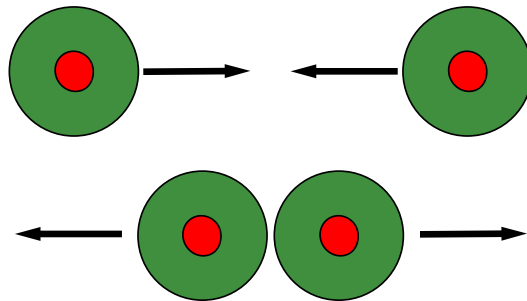**restricted search space for markers**

objects don't pass through each other

no infinite accelerations
model of bodies for occlusion