CS4620/5620: Lecture 31

Animation

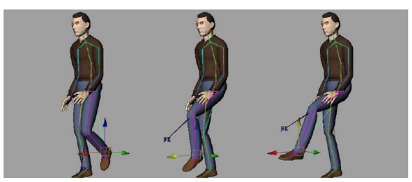
Animation

- Forward Kinematics
- Inverse Kinematics

- Forward Dynamics
- Inverse Dynamics

- Motion Capture

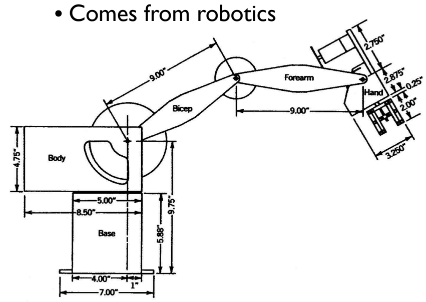
Forward Kinematics



Inverse Kinematics

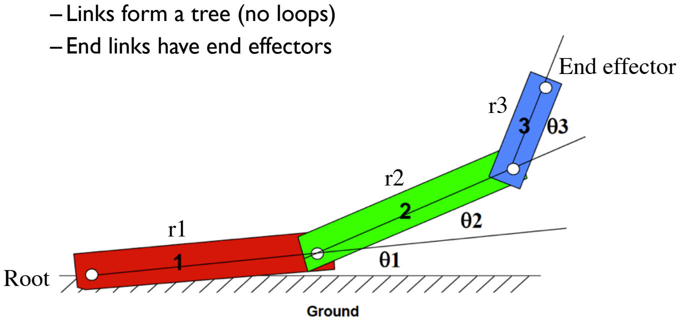
Forward Kinematics

- Articulated body
  - Hierarchical transforms
  - Comes from robotics



Rigid Links and Joint Structure

- Links connected by joints
  - Joints are purely rotational (single DOF)
  - Links form a tree (no loops)
  - End links have end effectors



$$M_1 = T(r_1)R(\theta_1)$$
$$M_2 = T(r_2)R(\theta_2)$$
$$M_1 = T(r_1)R(\theta_1)$$

$$M = M_1 M_2 M_3$$

Animation

- Forward Kinematics
- Inverse Kinematics

- Forward Dynamics
- Inverse Dynamics

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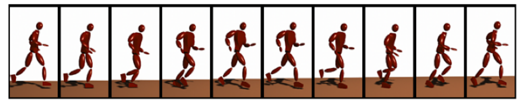
Motion capture



- A method for creating complex motion quickly: measure it from the real world

[thanks to Zoran Popović for many visuals]

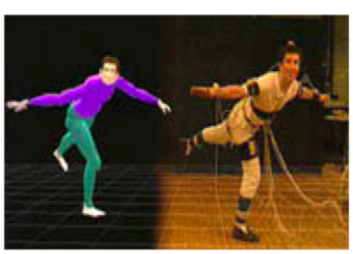
Motion capture in movies

[Final Fanatsy]

Motion capture in games

Magnetic motion capture

- Tethered
- Nearby metal objects cause distortions
- Low freq. (60Hz)



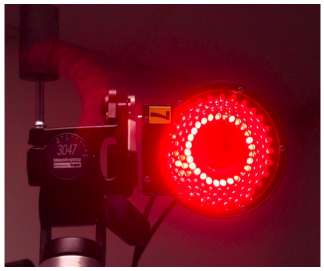
Mechanical motion capture

- Measures joint angles directly
- Works in any environment
- Restricts motion

Optical motion capture

- Passive markers on subject

Retroreflective markers



Cameras with IR illuminators

- Markers observed by cameras
  - Positions via triangulation

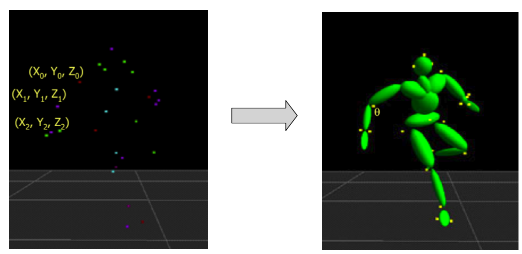
Optical motion capture

- 8 or more cameras
- Restricted volume
- High frequency (240Hz)
- Occlusions are troublesome

- 70 cameras, reflective dots, lightweight suit

From marker data to usable motion

- Motion capture system gives inconvenient raw data
  - Optical is "least information" case: accurate position but:
    - Which marker is which?
    - Where are the markers relative to the skeleton?



Motion capture data processing

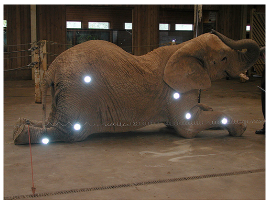
- Marker identification: which marker is which
  - Start with standard rest pose
  - Track forward through time (but watch for markers dropping out due to occlusion!)
- Calibration: match skeleton, find offsets to markers
  - Use a short sequence that exercises all DOFs of the subject
  - A nonlinear minimization problem
- Computing joint angles: explain data using skeleton DOFs
  - An inverse kinematics problem per frame!

Motion capture in context

- Mocap data is very realistic
  - Timing matches performance exactly
  - Dimensions are exact
- Therefore mocap data is generally a starting point for skilled animators to create the final product

Motion capture in context

- But it is not enough for good character animation
  - Too few DOFs
  - Noise, errors from nonrigid marker mounting
  - Contains no exaggeration
  - Only applies to human-shaped characters



Kinect: Xbox 360

- Camera and IR