CS130 : Computer Graphics
Animation
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Types of animation

• keyframing
• rotoscoping
• stop motion
• procedural
• simulation
• motion capture
history
Gertie the Dinosaur

1914
12 minutes
hand drawn
keyframe animation
registration
cycling

link
Traditional animation

Cels

Multiplane camera

Sleeping Beauty, Disney, 1959
Realistic 3D animation

- Disney’s Tron, 1981
- Pixar’s Toy Story, 1995, first 3D feature
Performance capture

Rise of the Planet of the Apes, 2011

Lord of the Rings, 2001

Avatar, 2009
Paperman and the Future of 2D Animation
animation principles
The famous half-filled flour sack, guide to maintaining volume in any animatable shape, and proof that attitudes can be achieved with the simplest of shapes.
12 principles of animation

1. Squash and stretch
2. Anticipation
3. Staging
4. Straight ahead action and pose to pose
5. Follow through and overlapping action
6. Slow in and slow out
7. Arcs
8. Secondary action
9. Timing
10. Exaggeration
11. Solid drawing
12. Appeal
Physics-based animation

- Many animation principles follow from underlying physics
  - anticipation, follow through, secondary action, squash and stretch, ...

- Spacetime Constraints, Witkin and Kass 1988
keyframe animation
Keyframe animation

- draw a series of poses
- fill in the frames in between ("inbetweening")
- computer animation uses interpolation

http://anim.tmog.net
Luxo Jr.
forward kinematics

After hip rotation

Original

After knee rotation

forward kinematics

IK solver connection

hip and knee joint angles computed automatically

inverse kinematics

Effector motion

[Shirley and Marschner]
multiple possible states of joints
Keyframe character DOFs

3 translational DOFs

48 rotational DOFs

Each joint can have up to 3 DOFs
Interpolation of keyframes

linear interpolation

spline interpolation

Straightforward to interpolate position but what about orientation?
need to consider both shape of motion and speed of motion
Character Skinning

[McAdams et al. 2011]
Character Skinning

[McAdams et al. 2011]
free form deformation

[Sederberg 1986]

[Shirley and Marschner]
facial animation
procedural animation
Artificial life

- plants - movement and growth
- evolving artificial life
Crowd simulation

[Treuille et al. 2006]