Animation

Keyframe Animation

These icons refer to explanatory videos on the class web site

anim2.mp4

Forward Kinematics: Transformation Hierarchies

Locations?

Forward Kinematics: Change Parameters – Things Move
(All Children Understand This)
Inverse Kinematics (IK):
Things Need to Move to a Particular Location –
What Parameters Will Make Them Do That?

Of course, there will always be target locations that can never be reached. Think about that spot in the middle of your back that you can never scratch!

Inverse Kinematics (IK) solves the problem "If I know where I want the end of the chain to be (X*, Y*), what transformation parameters will put it there?"

Ground

Particle Systems:
A Cross Between Modeling and Animation?

The basic process is:
- Emit
- Random Number Generator
- Display
- Update
Particle Systems Examples

Particle Systems Examples

A Particle System to Simulate Colliding Galaxies in *Cosmic Voyage*
**Particles Don’t Actually Have to Be “Particles”**

**Animating using Physics**

1. Newton’s first law: 
   \[ \text{force} = \text{mass} \times \text{acceleration} \]
   or
   \[ \text{acceleration} = \frac{\text{force}}{\text{mass}} \]

2. **D-D0**
   - \( k \) = spring stiffness in Newtons/meter or pounds/inch
   - \( F = F_D \)
   - Or, if you know the displacement, the force exerted by the spring is:
     \[ F = k \left( D - D_0 \right) \]

   **This is known as Hooke’s law**

3. **Animating using the Physics of a Mesh of Springs**
Simulating a Bouncy String

Placing a Physical Barrier in the Scene

Animating Cloth
Cloth Examples

Cloth Example

Cloth Example

Functional Animation:
Make the Object Want to Move Towards a Goal Position

\[ m\ddot{x} + c\dot{x} + kx = 0 \]
**Functional Animation:**
While Making it Want to Move Away from all other Objects

\[ m \ddot{x} = \sum F_{\text{repulsive}} \]

**Total Goal – Make the Free Body Move Towards its Final Position**
While Being Repelled by the Other Bodies

\[ m \ddot{x} + c \dot{x} + kx = \sum F \]

**Increasing the Stiffness**
Stiffness = 3, 6, 9

**Increasing the Repulsion Coefficient**
Repulse = 10, 30, 50
Functional Animation

Motion Capture as an Input for Animation

Motion Capture is for Faces Too

Tron I –
Probably should have used physics, but didn’t