Animation

Keyframe Animation

These icons refer to explanatory videos on the class web site

anim2.mp4
Forward Kinematics: Change Parameters – Connected Things Move
(All Tinker Toy users understand this)

Forward Kinematics: Transformation Hierarchies
Determine Object Locations?

Ground
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! 😊

Forward Kinematics solves the problem “if I know the link transformation parameters, where are the links?”.

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?”

(X*,Y*)
Particle Systems: A Cross Between Modeling and Animation?

The basic process is:

1. Emit
2. Random Number Generator
3. Display
4. Update

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

Oregon State University
Computer Graphics
Chuck Evans

particles.mp4
Particle Systems Examples

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

Newton’s first law:
force = mass * acceleration
or
acceleration = force / mass

Animating using Physics

dominos.mp4
**Computer Graphics**

**D-D0**

$k = \text{spring stiffness} \text{ in} \ \text{Newtons/meter or pounds/inch}$

$F = k(D - D_0)$

This is known as Hooke’s law

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**Lumped Masses**

**Animating using the Physics of a Mesh of Springs**
Placing a Physical Barrier in the Scene

Animating Cloth
Cloth Examples

cloth.mp4

Cloth Example

cloth.mp4
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

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

- Repulsion Coefficient
- \[ F_{\text{repulsive}} = \frac{c_{\text{repulse}}}{d}\text{Power} \]
- Distance between the boundaries of the 2 bodies
- Repulsion Exponent

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

Stiffness = 6

Stiffness = 9

Increasing the Repulsion Coefficient

Repulse = 10

Repulse = 30
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
Card Trick

Pixar Animated Shorts