Computer Graphics

Keyframe Animation

These icons refer to explanatory videos on the class web site.

1

Forward Kinematics:
Change Parameters – Things Move
(All Children Understand This)

1

Ground

2

Forward Kinematics: Transformation Hierarchies

Locations?

3

Inverse Kinematics (IK):
Things Need to Move to a Particular Location –
What Parameters Will Make Them Do That?

4

Inverse Kinematics (IK)

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!

5

Inverse Kinematics (IK)

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?”.

6
Particle Systems: A Cross Between Modeling and Animation?

The basic process is:

- Emit
- Random Number Generator
- Display
- Update

Particle Systems Examples

- particles.mp4

Particle Systems Examples

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

Animating using Physics

Newton’s first law:

\[ \text{force} = \text{mass} \times \text{acceleration} \]

or

\[ \text{acceleration} = \frac{\text{force}}{\text{mass}} \]

D-D₀

In Newtons/meter or pounds/inch

\[ F = k (D - D₀) \]

Or, if you know the displacement, the force exerted by the spring is:

This is known as Hooke’s law

“Lumped Masses”

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

$$ m\ddot{x} = \sum F_{\text{repulsive}} $$

- Repulsion Coefficient
- 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, 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

Card Trick

Pixar Animated Shorts