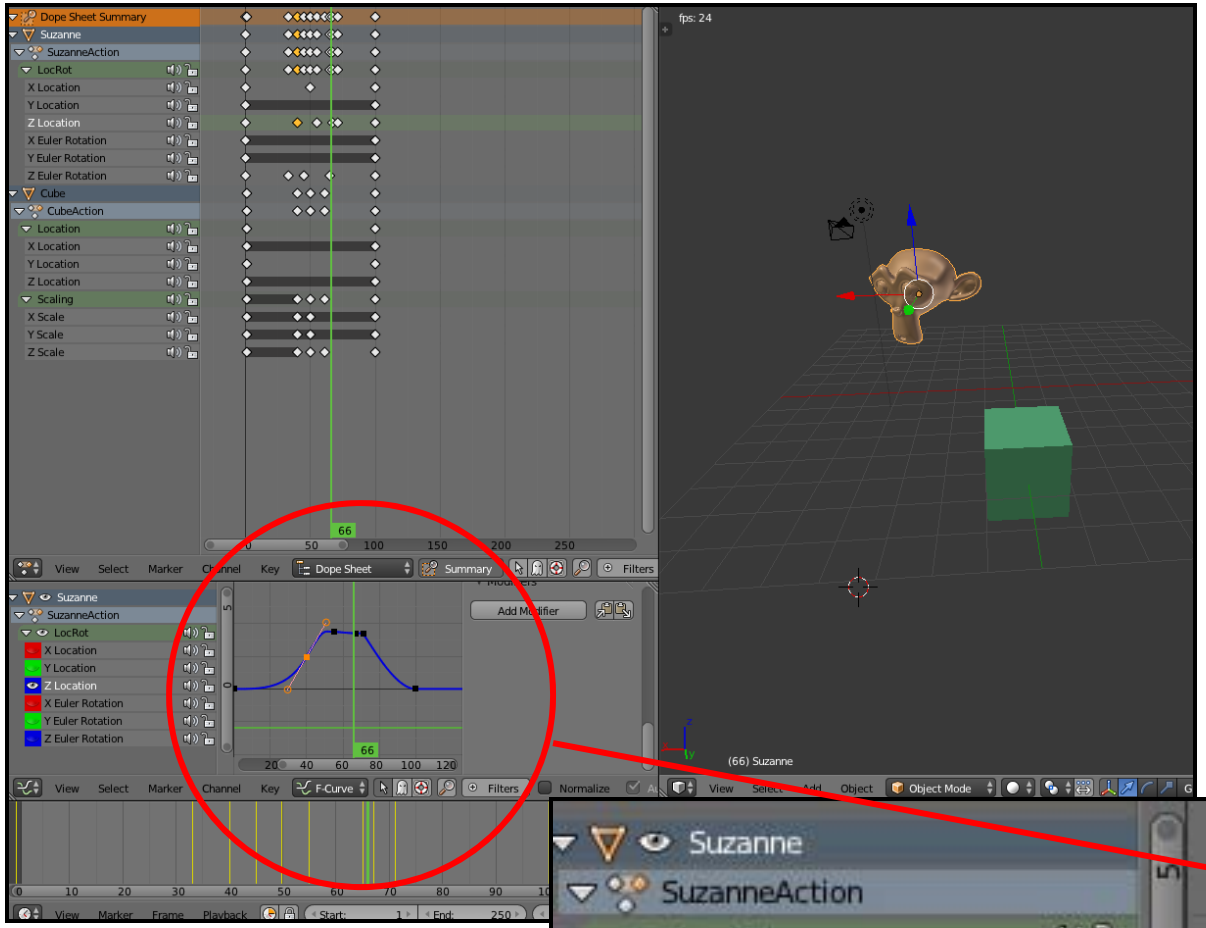
Animation

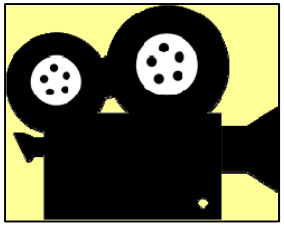
Mike Bailey

mjb@cs.oregonstate.edu

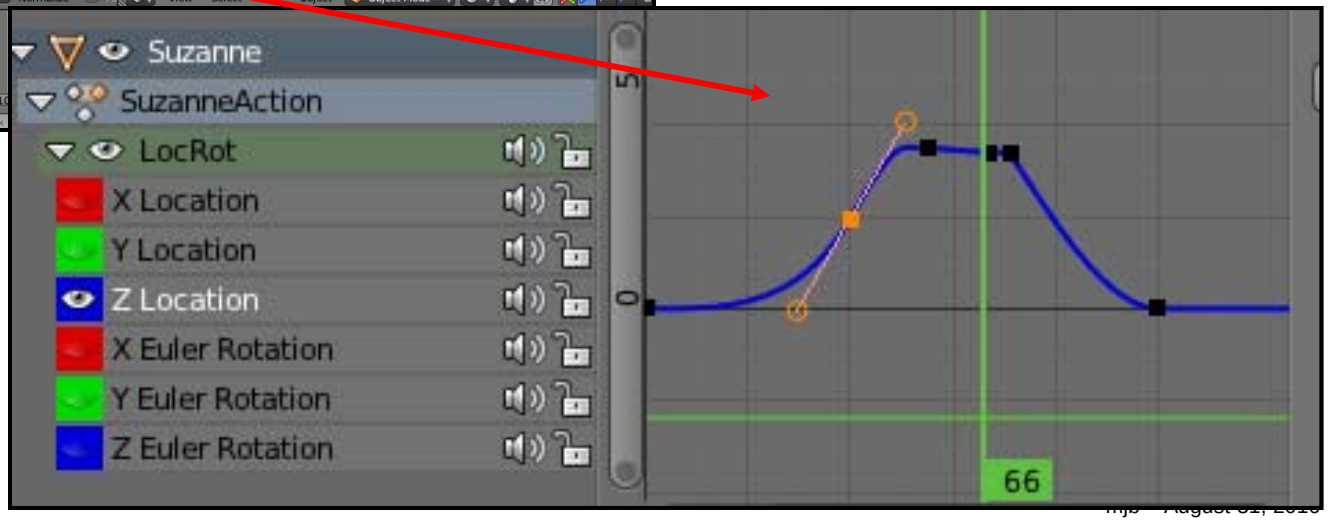
Oregon State University

Keyframe Animation

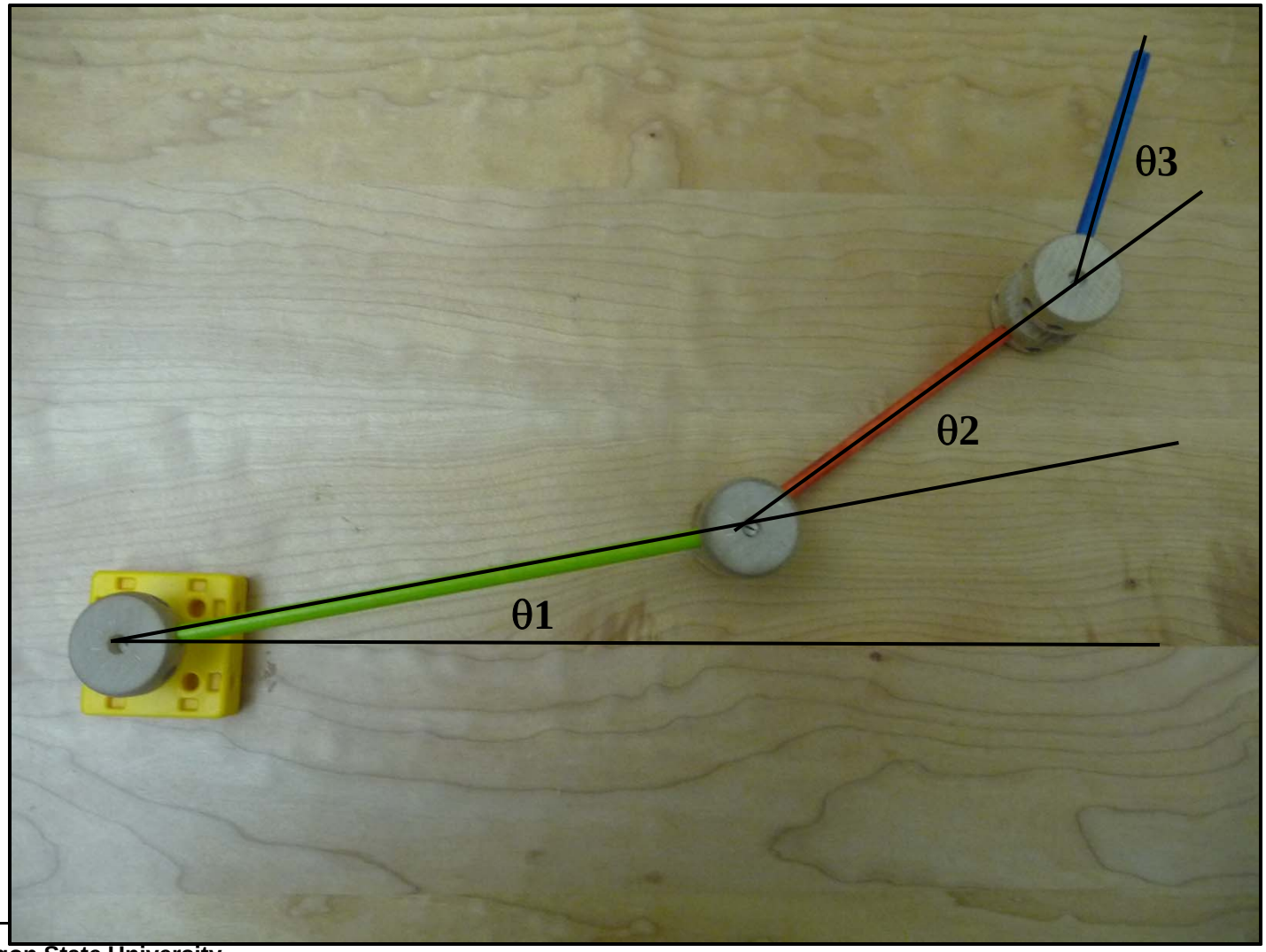




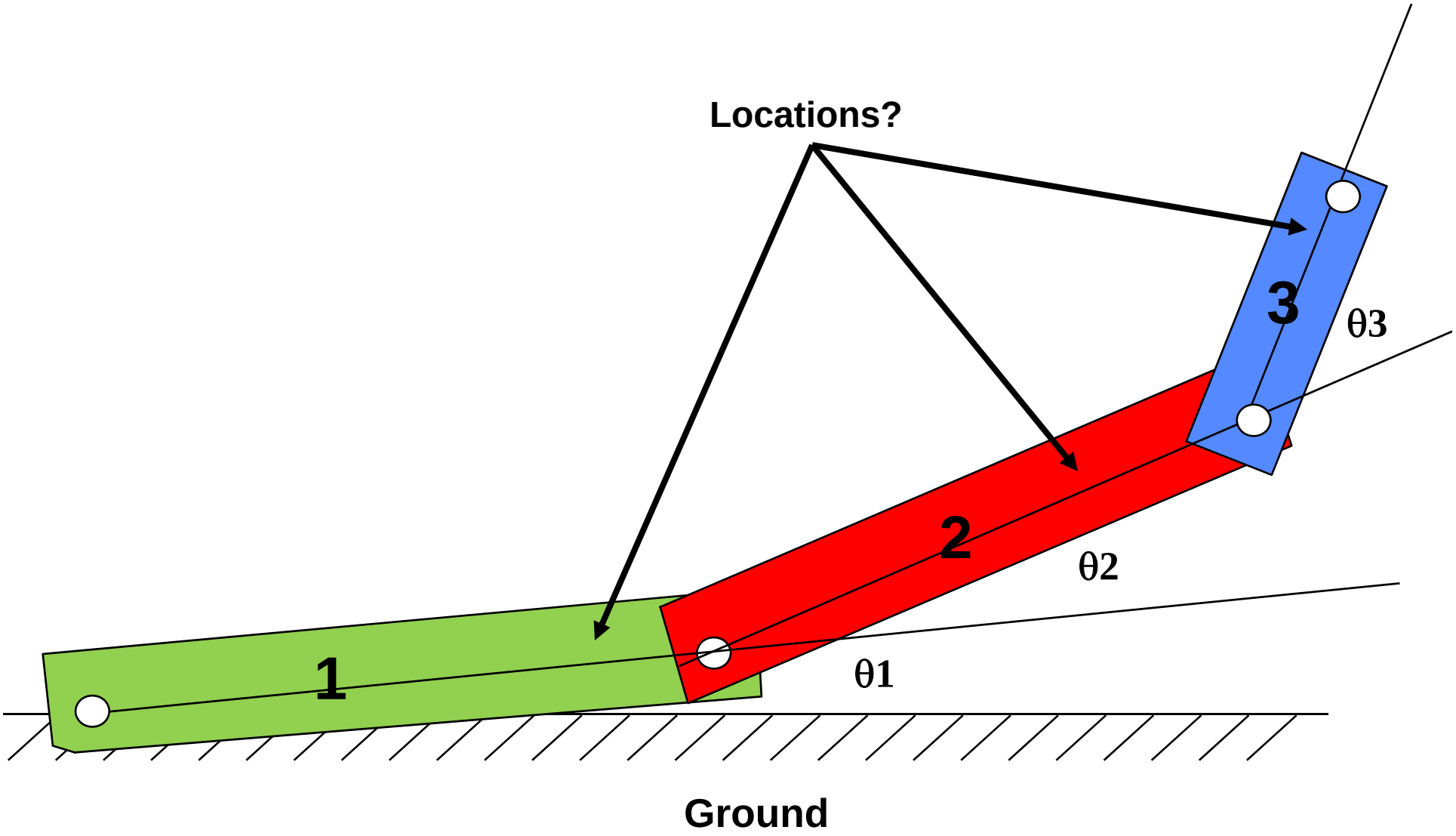
anim2.mp4



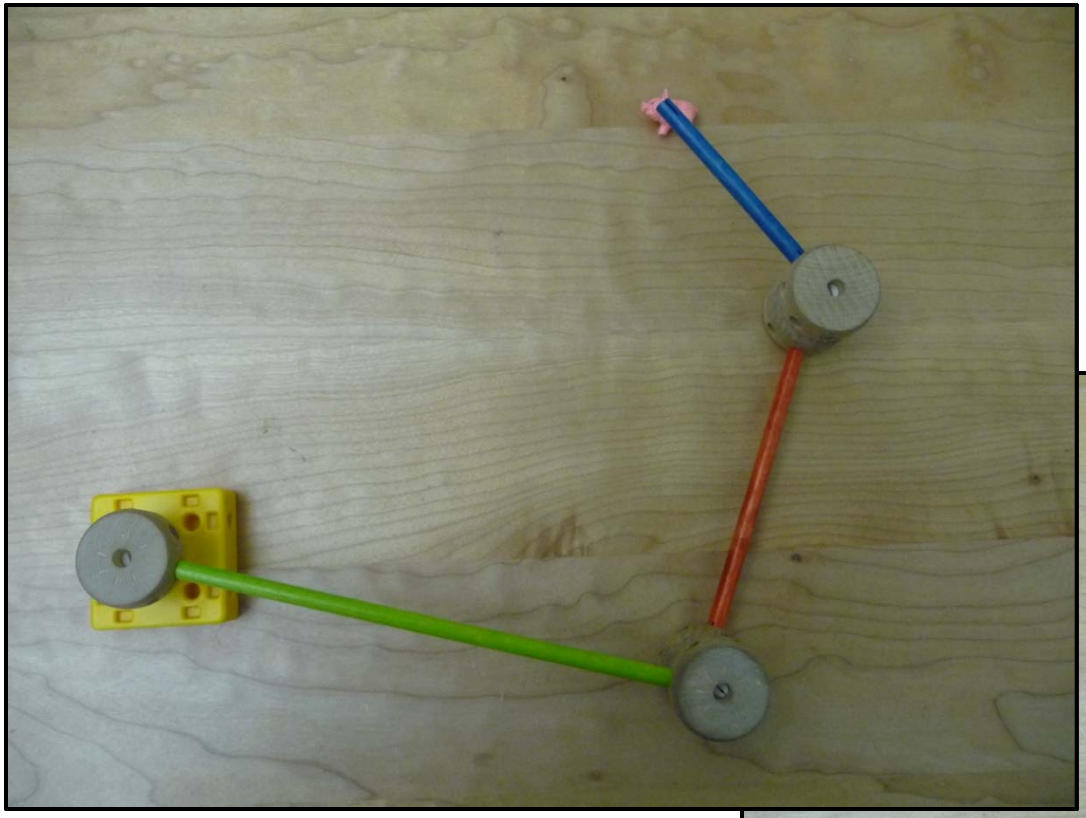
Forward Kinematics:
Change Parameters – Things Move
(All Children Understand This)

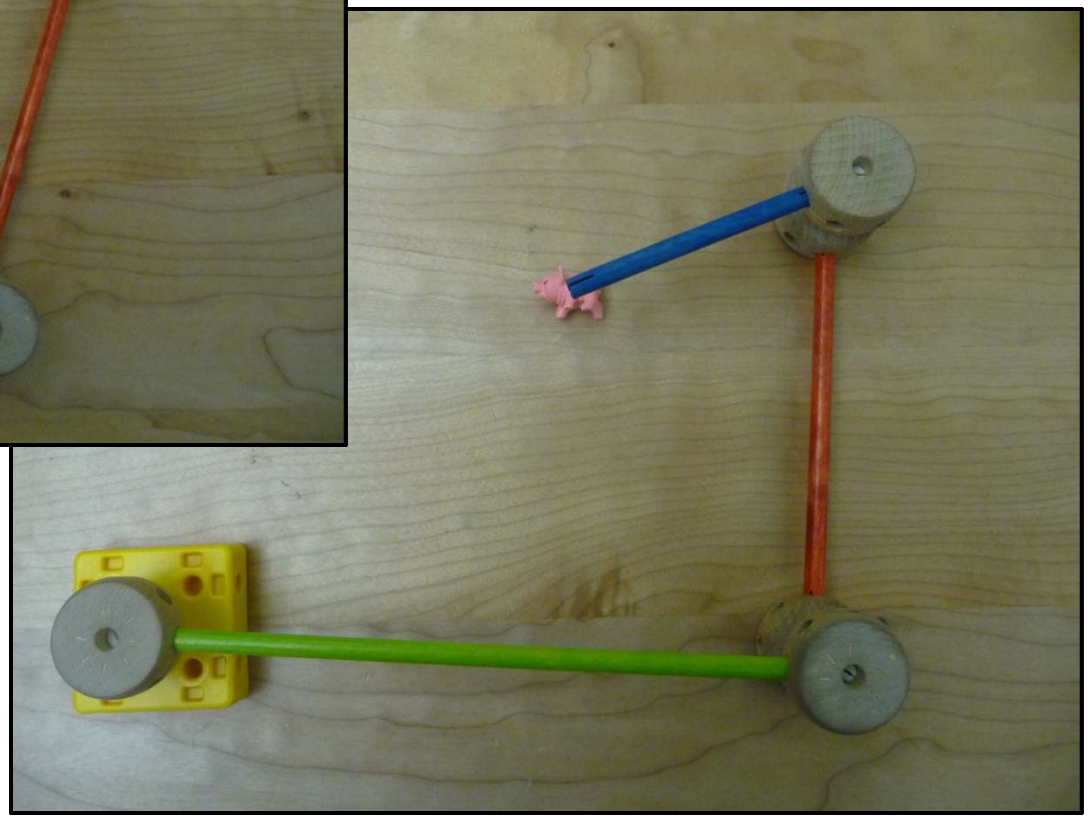


Forward Kinematics: Transformation Hierarchies



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

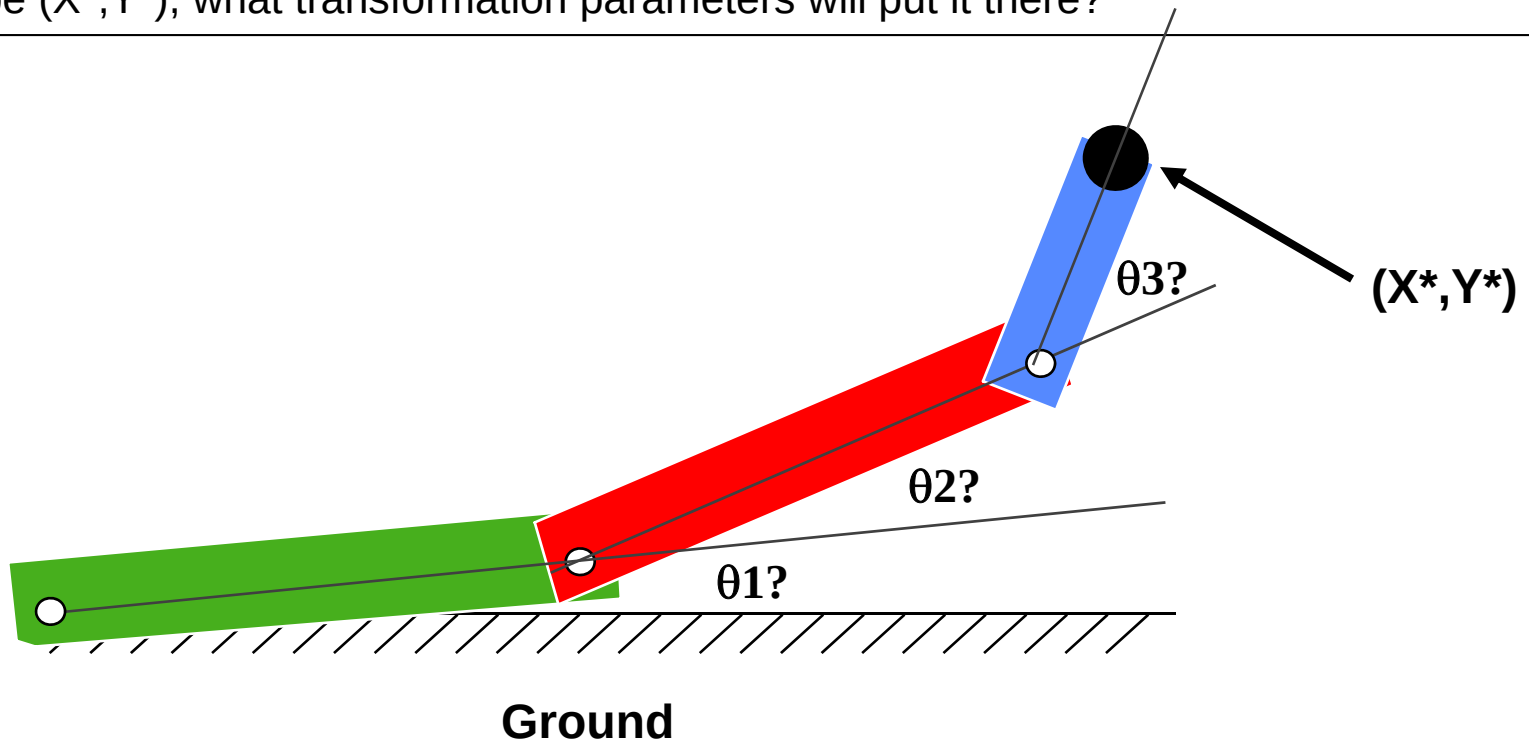




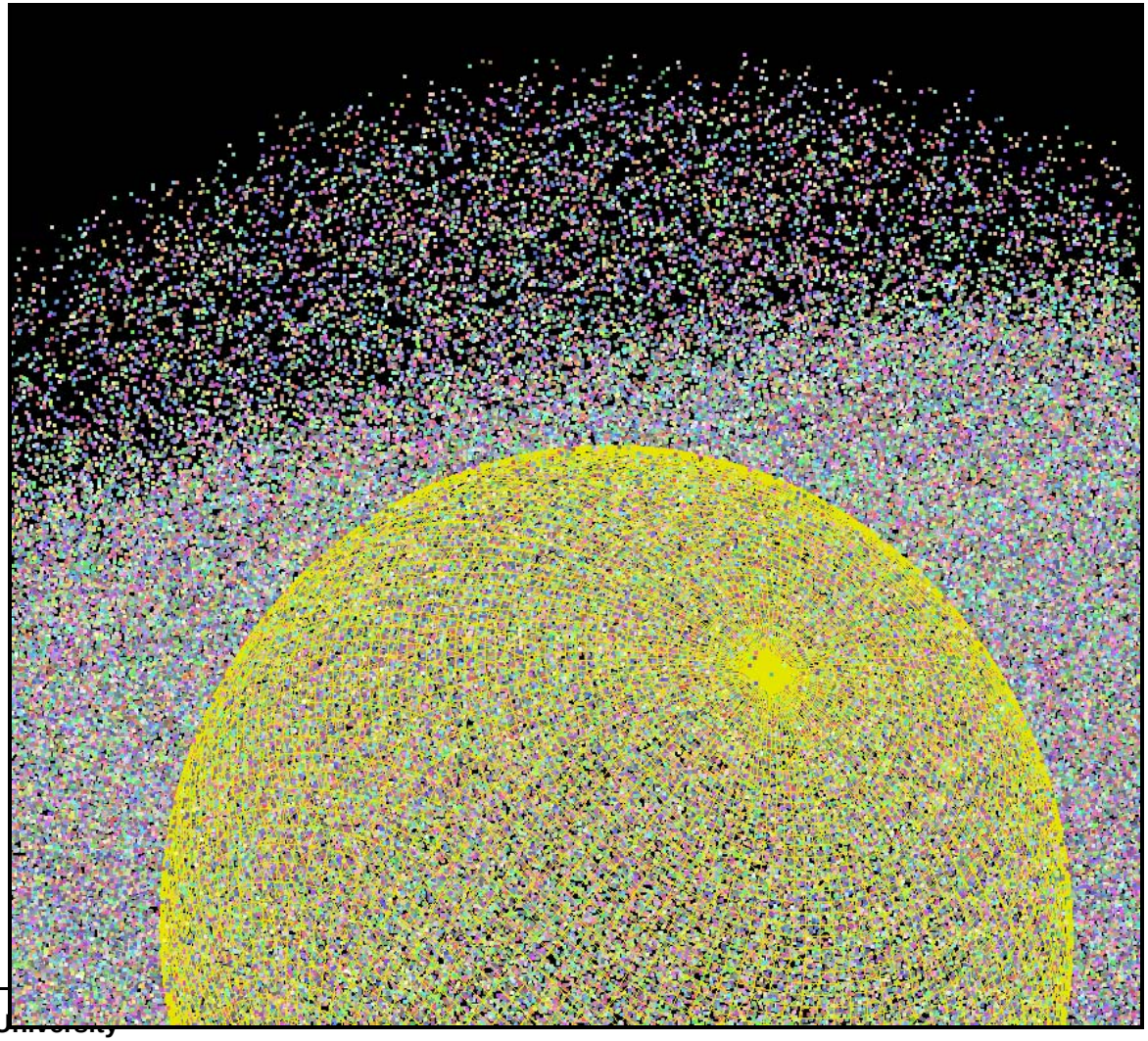
Inverse Kinematics (IK)

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?"

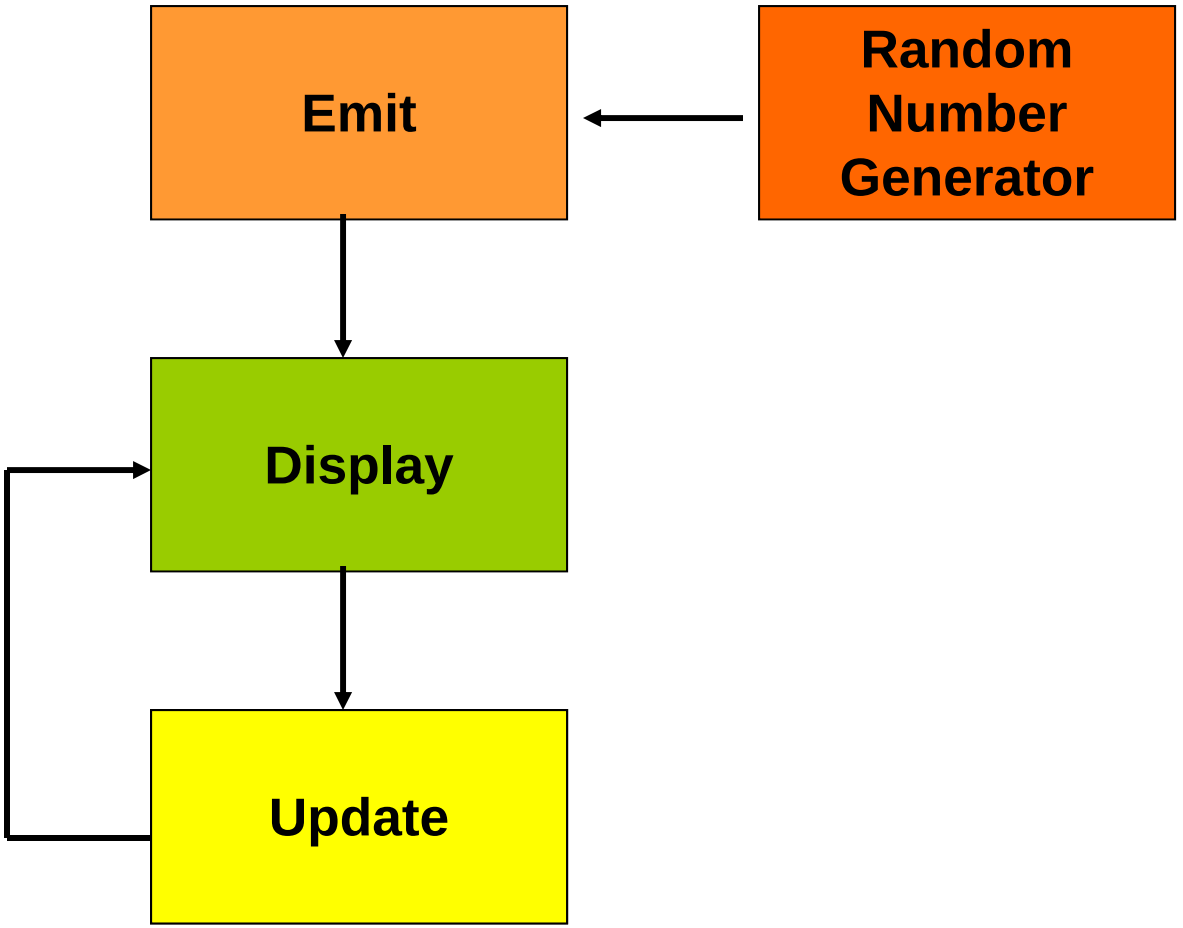


Particle Systems:
A Cross Between Modeling and Animation?

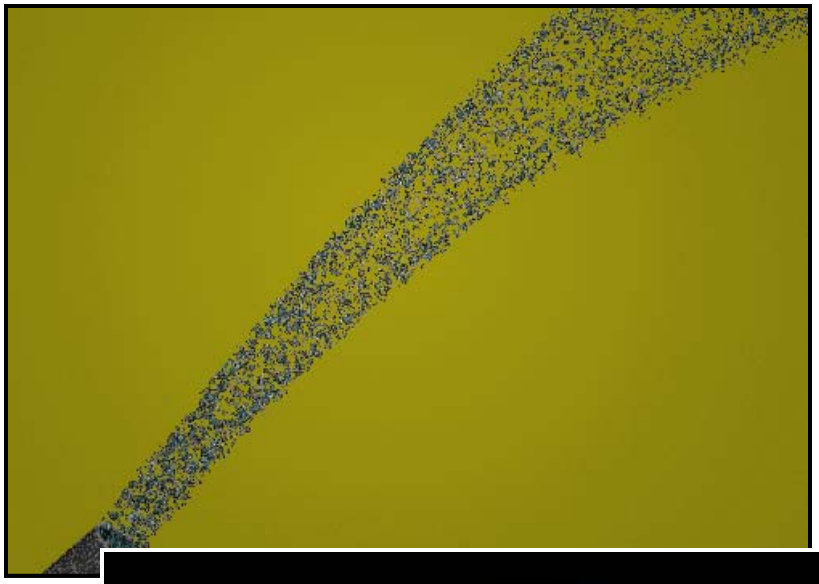


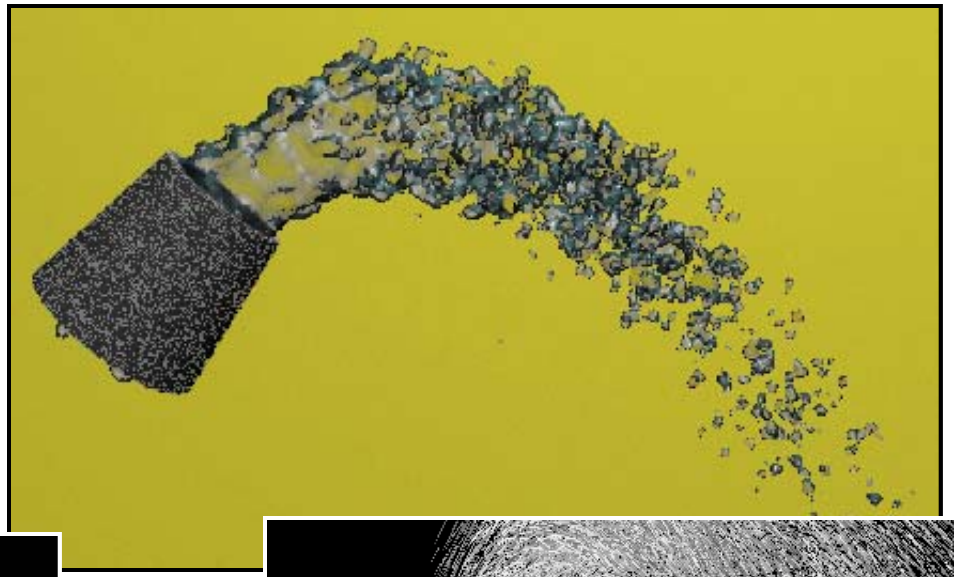
Particle Systems:
A Cross Between Modeling and Animation?

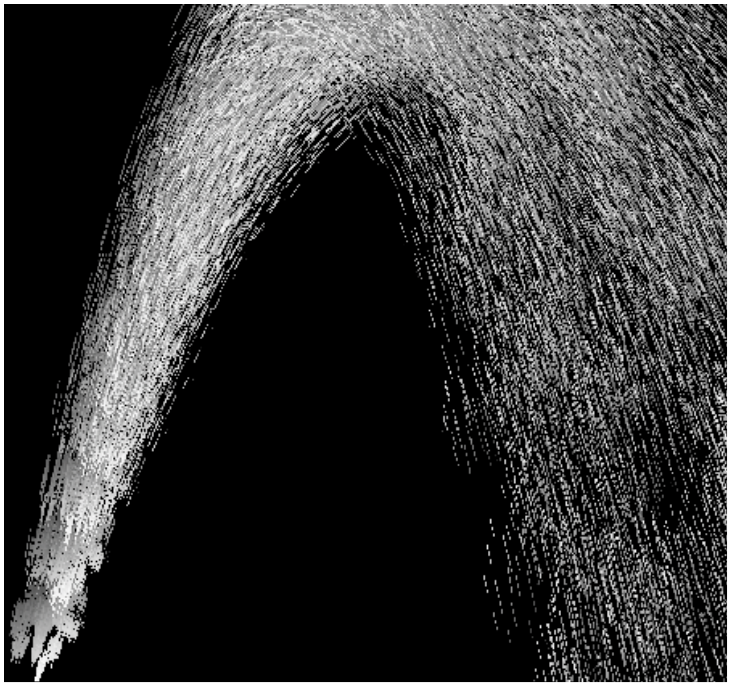
The basic process is:



Particle Systems Examples

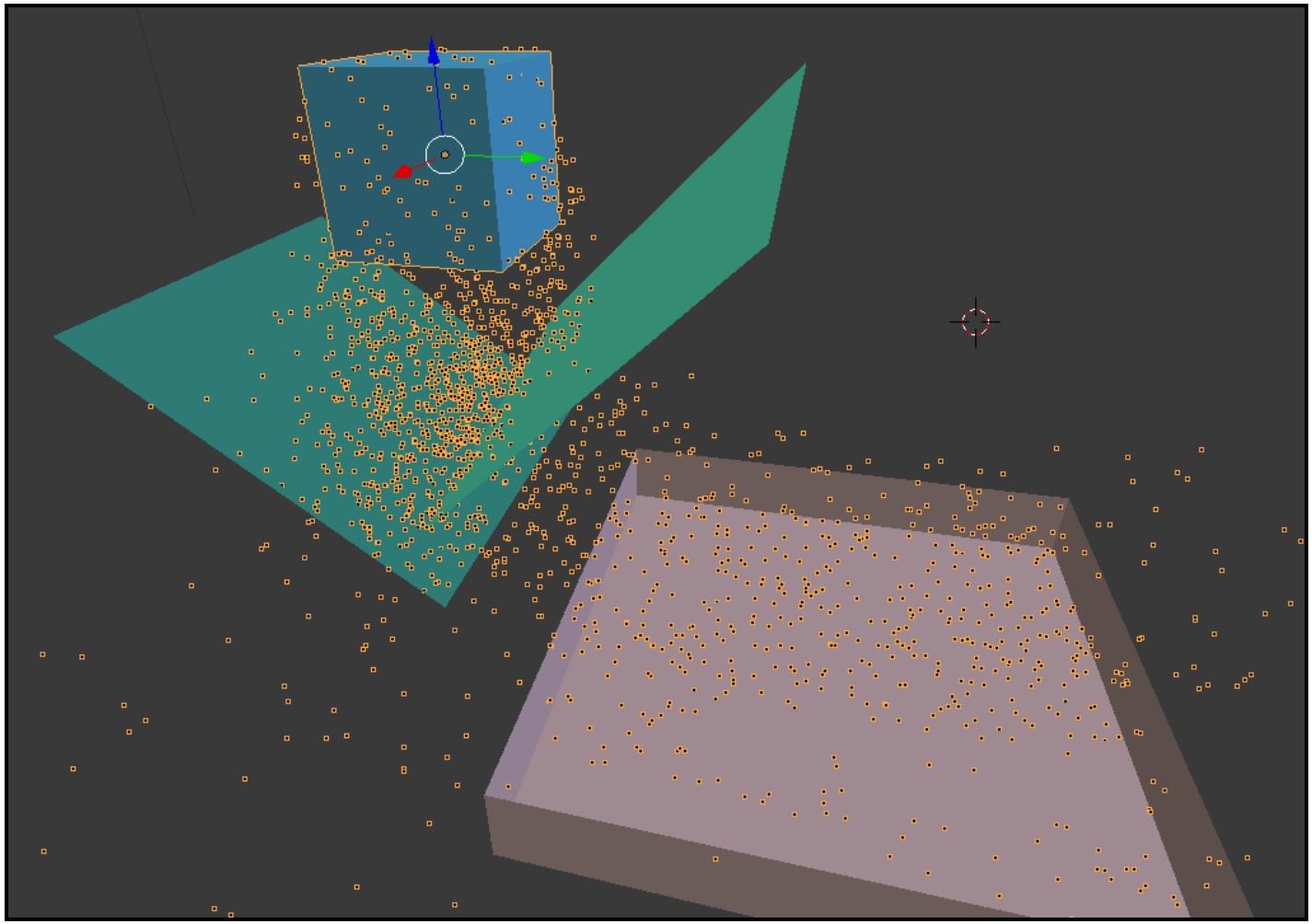


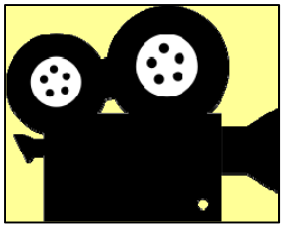




Chuck Evans

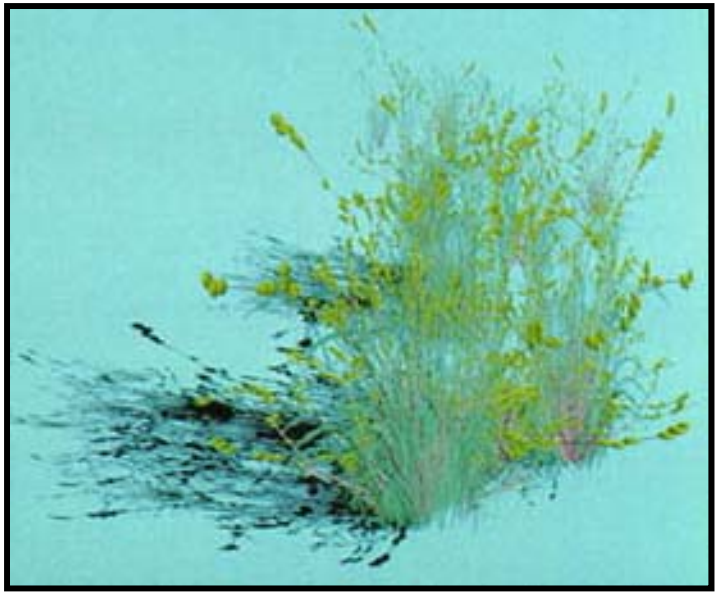
Particle Systems Examples





particles.mp4

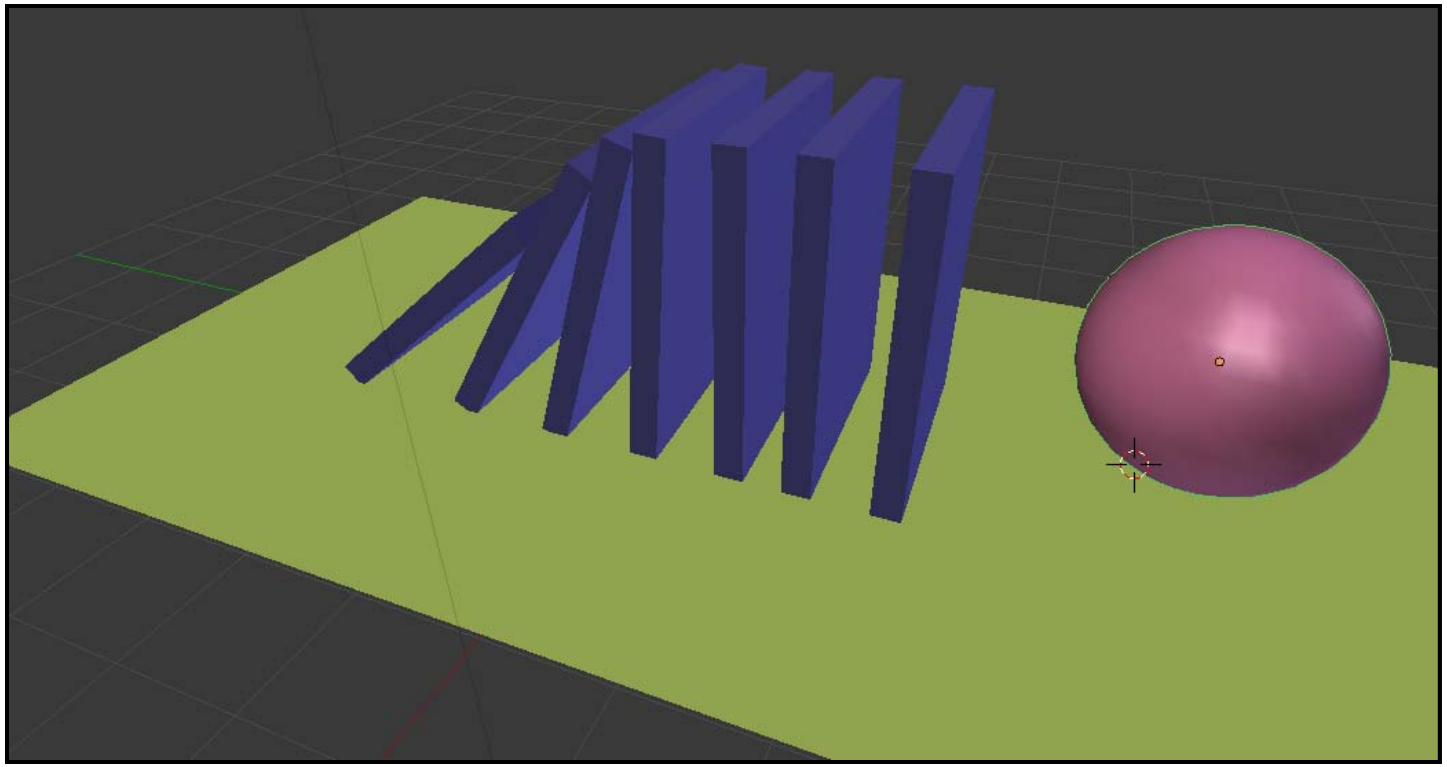
Particle Systems Examples

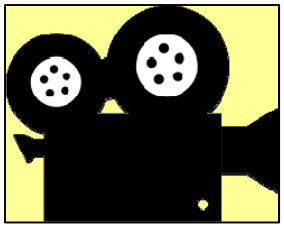


A Particle System to Simulate Colliding Galaxies in *Cosmic Voyage*

Particles Don't Actually Have to Be "Particles"

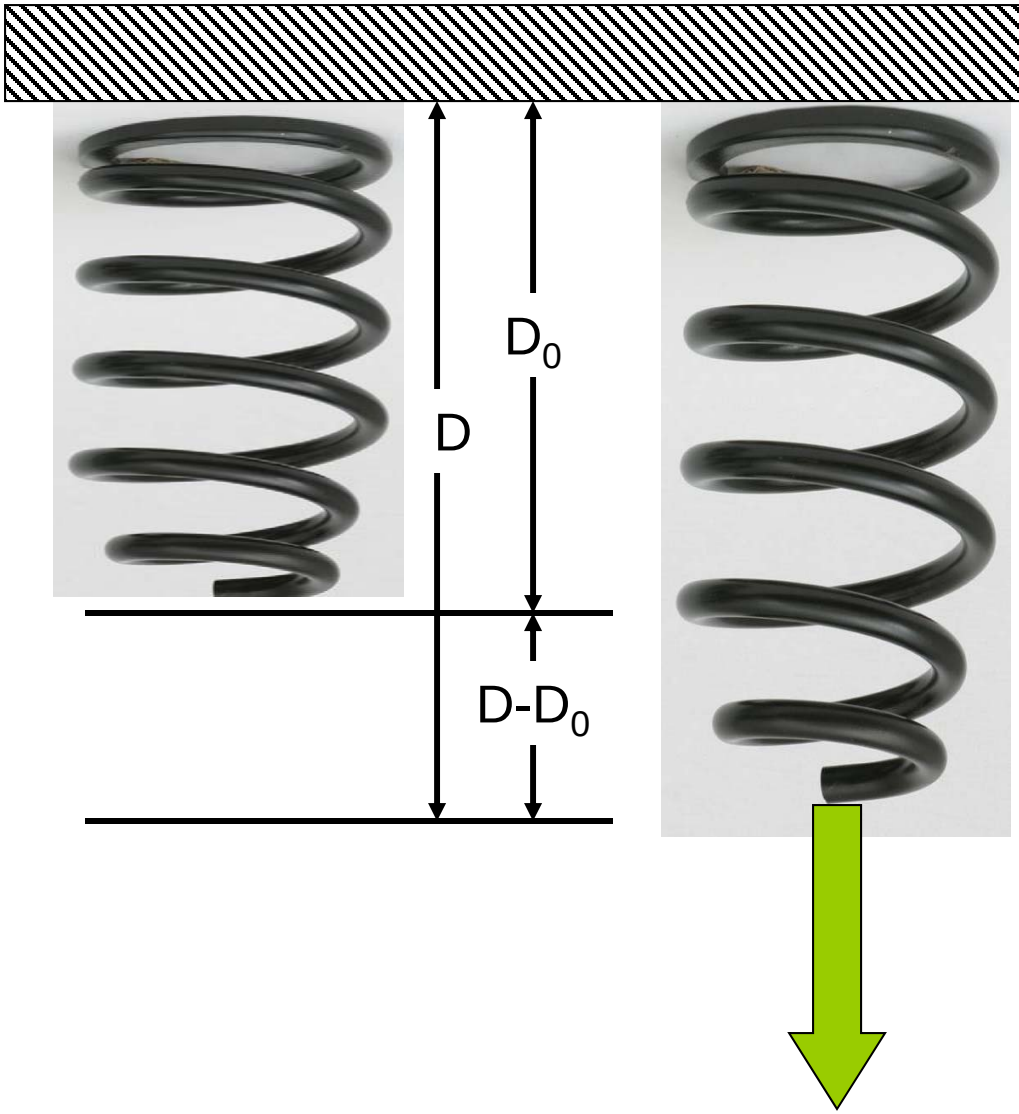
Animating using Physics





dominos.mp4

Animating using Physics



D_0 = unloaded spring length

$$(D - D_0) = \frac{F}{k}$$

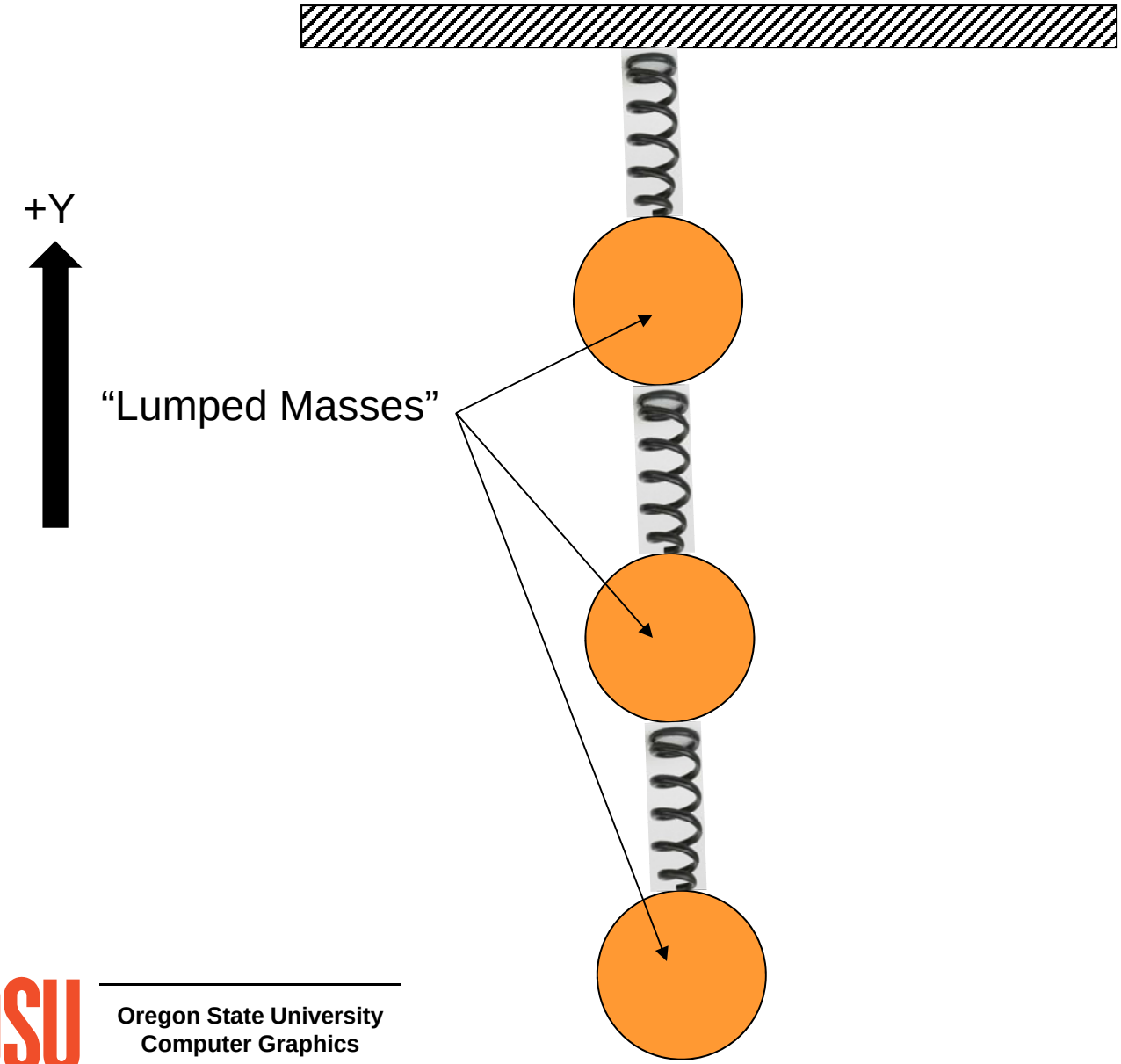
k = ***spring stiffness*** in Newtons/meter or pounds/inch

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

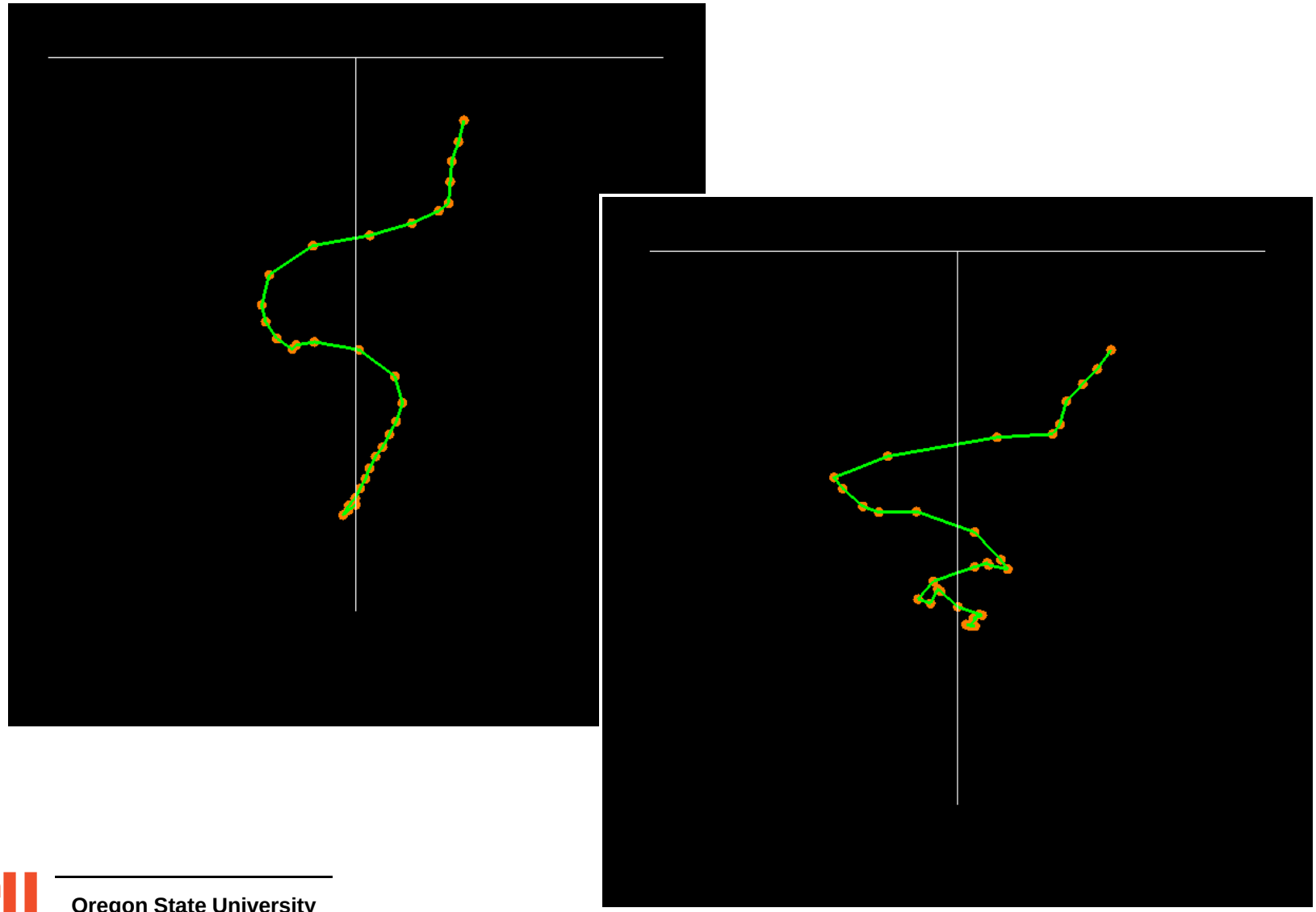
$$F = k\left(D - D_0\right)$$

This is known as Hooke's law

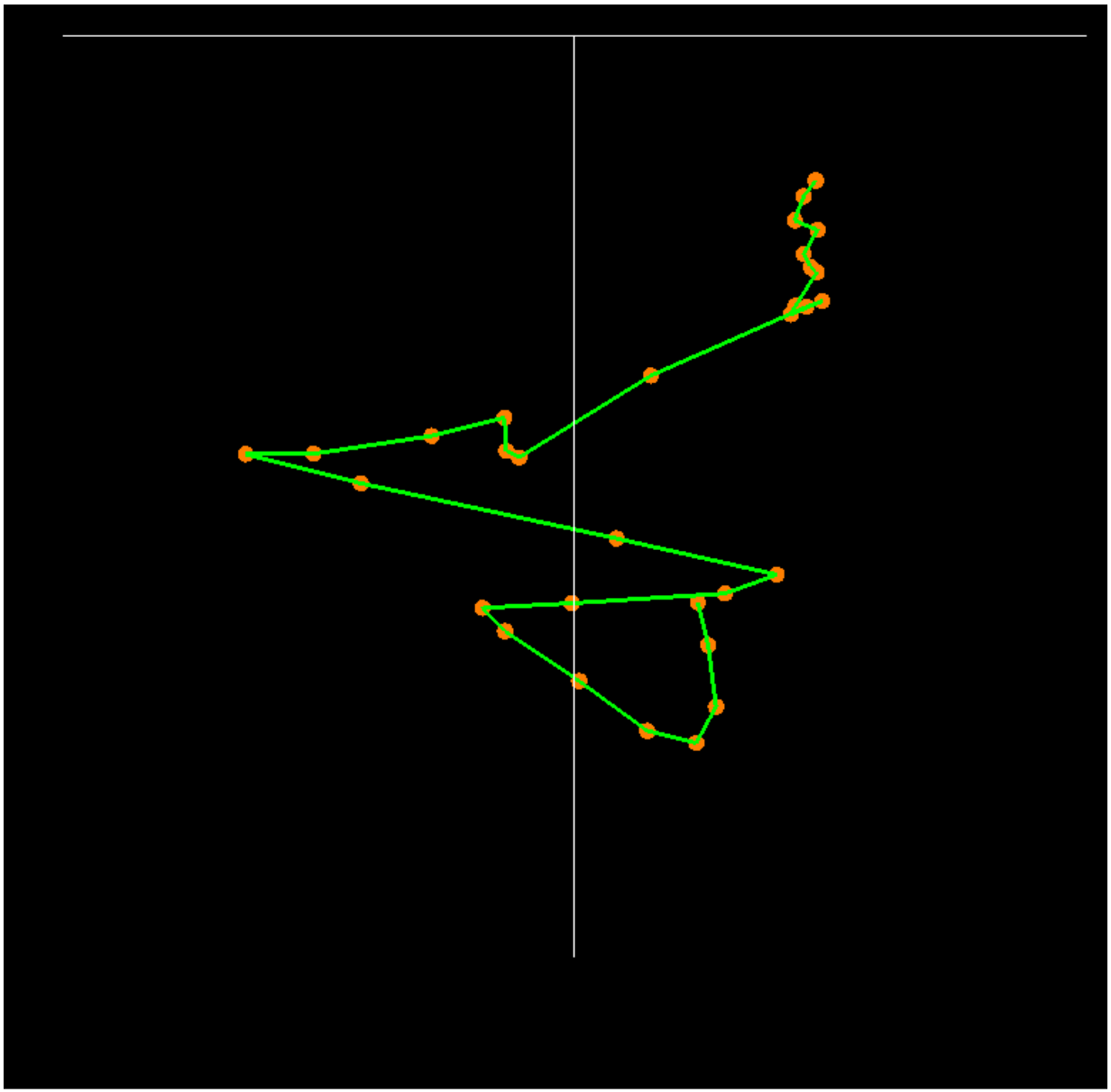
Animating using the Physics of a Mesh of Springs

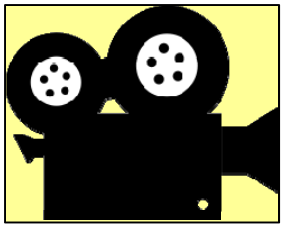


Simulating a Bouncy String



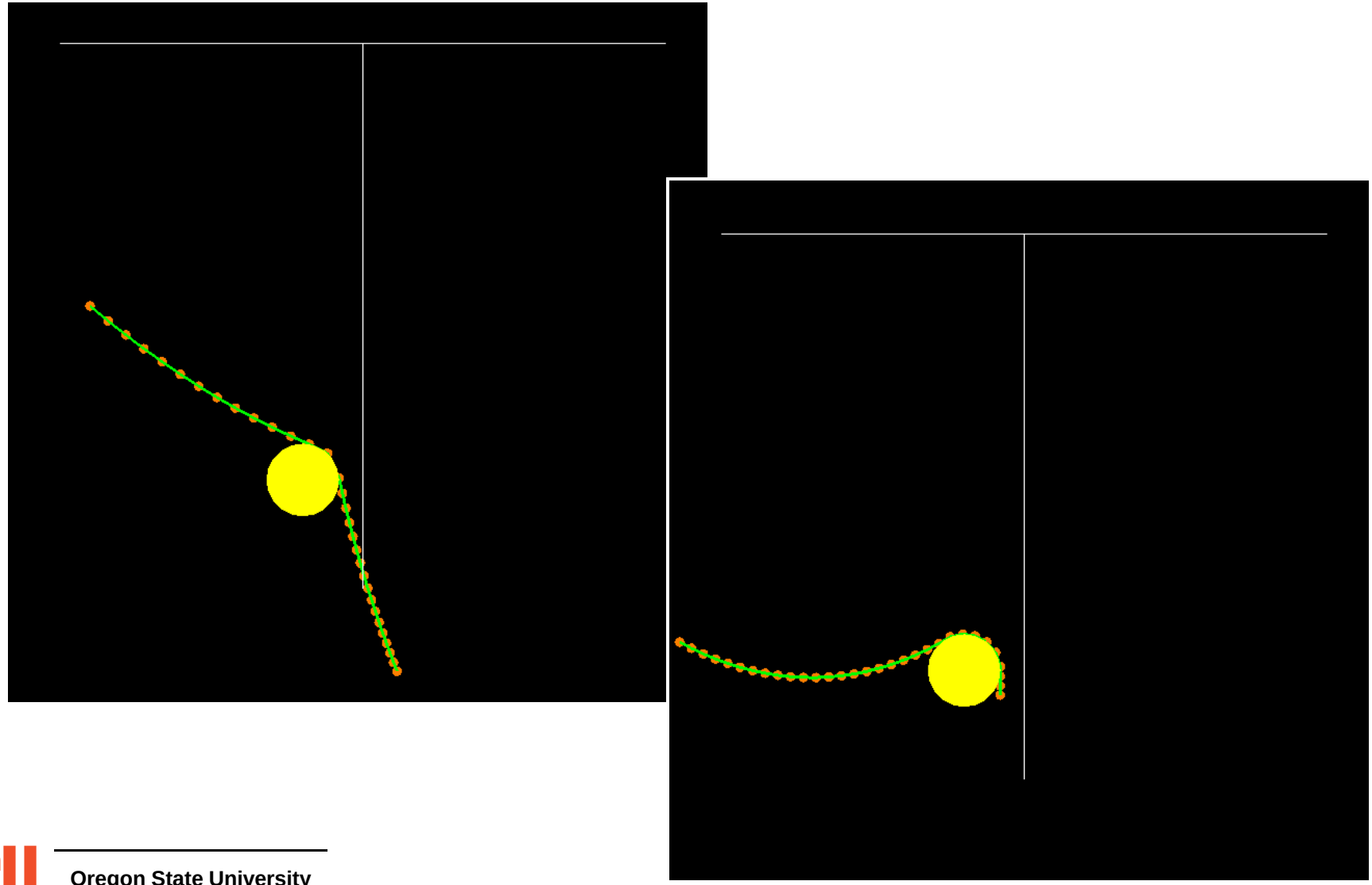
Simulating a Bouncy String



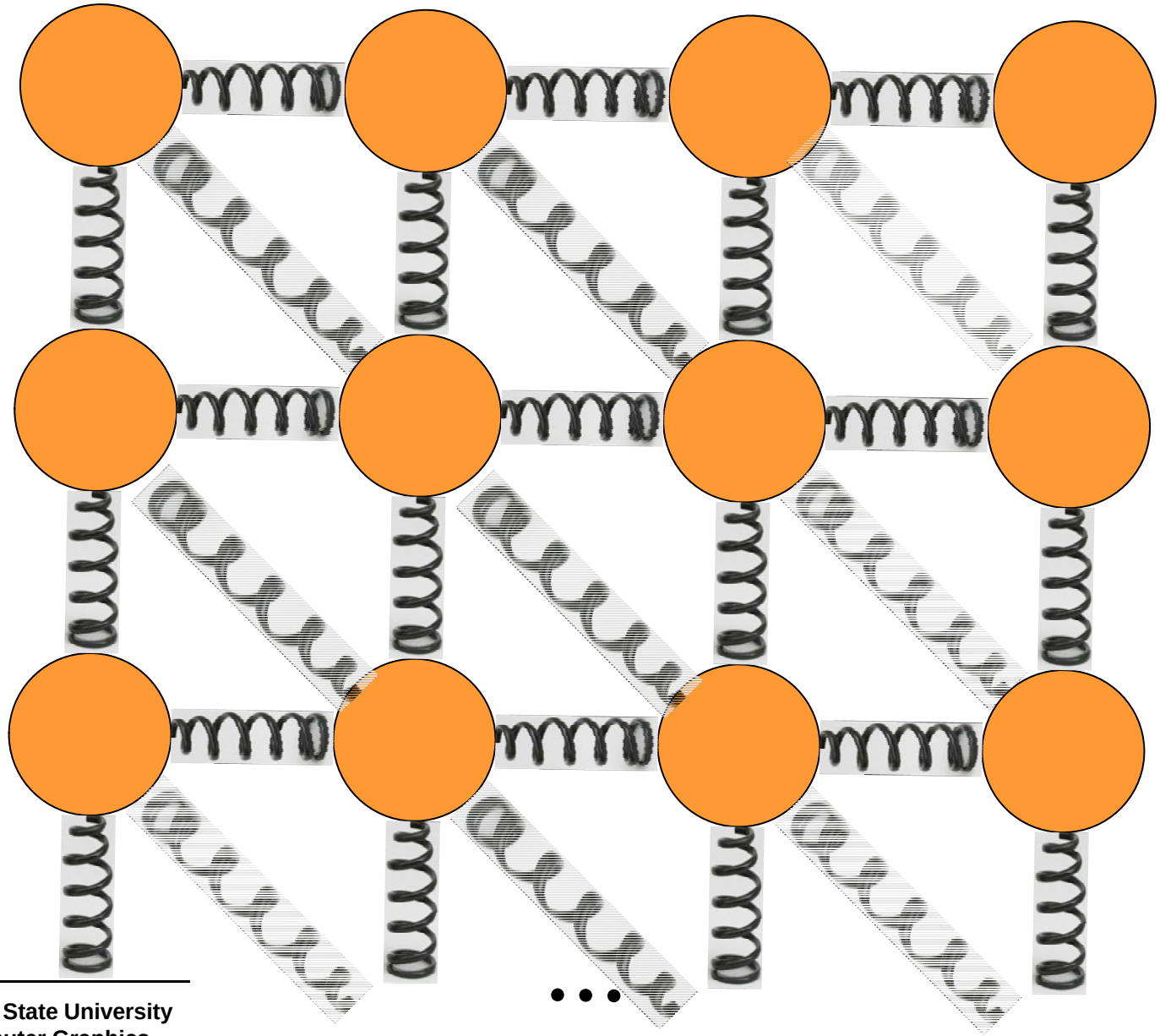


string.mp4

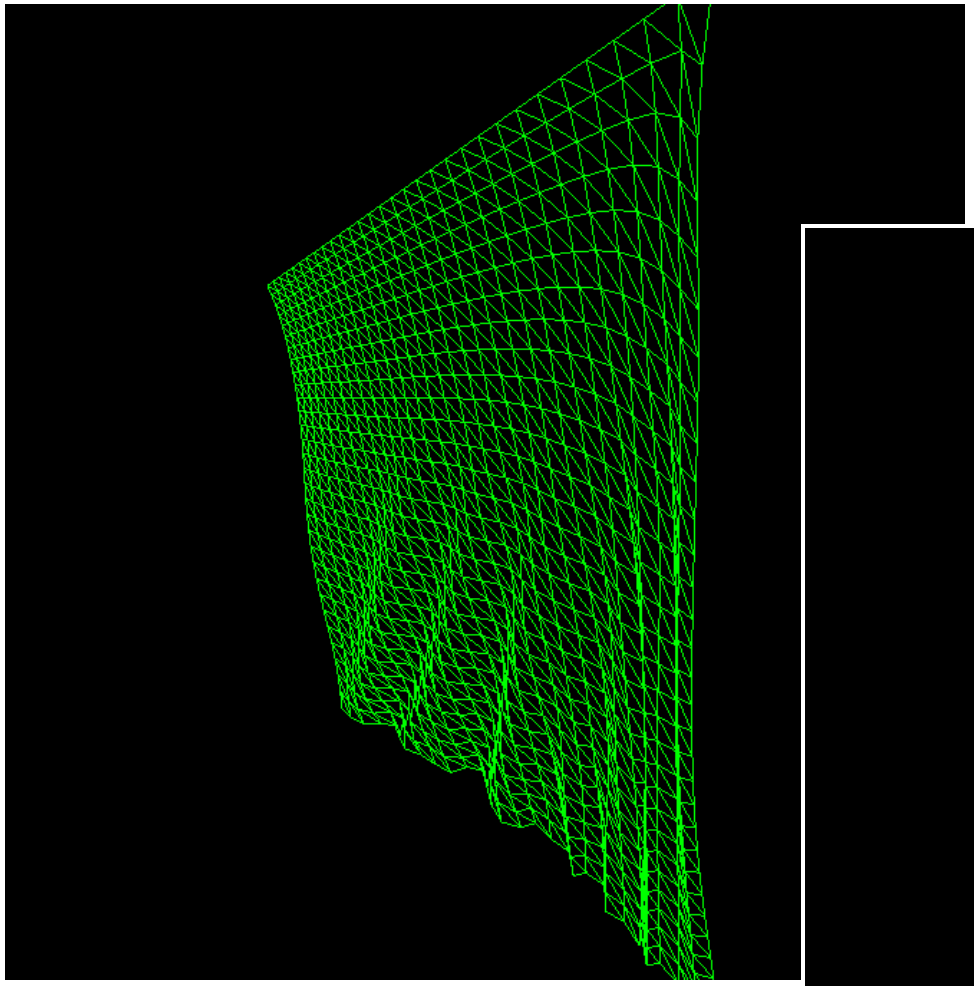
Placing a Physical Barrier in the Scene

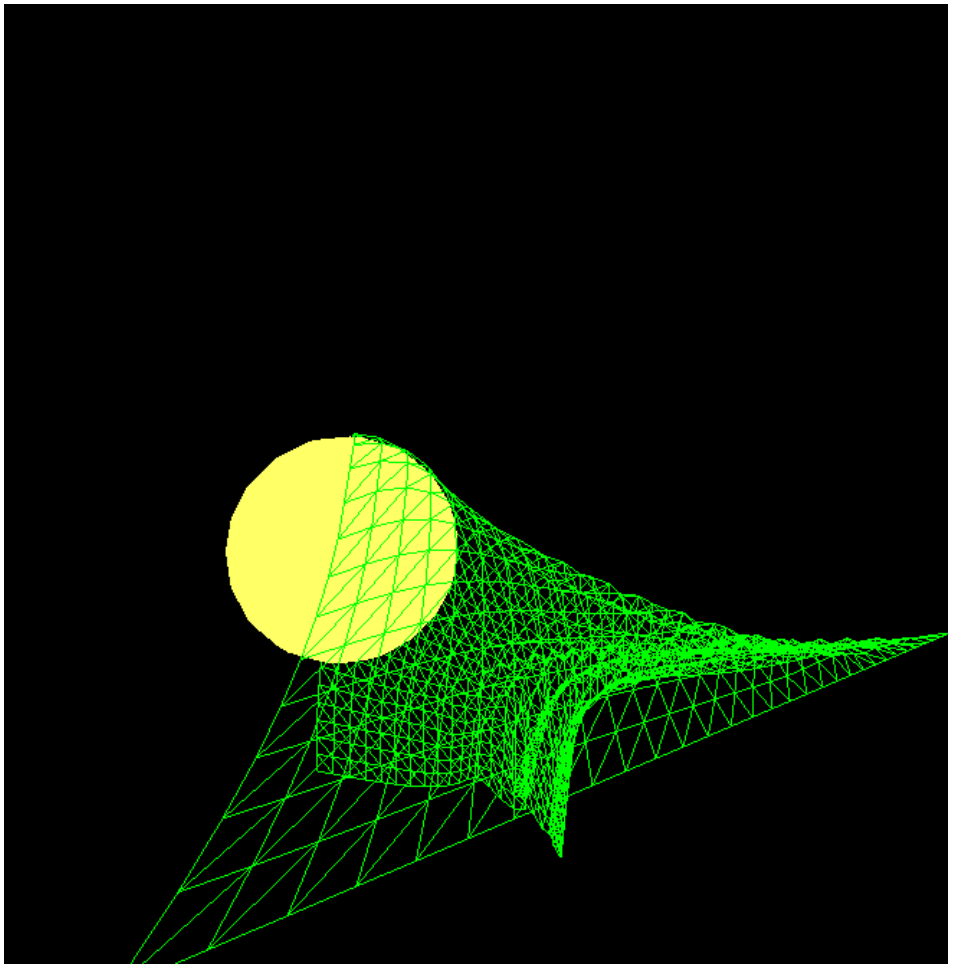


Animating Cloth

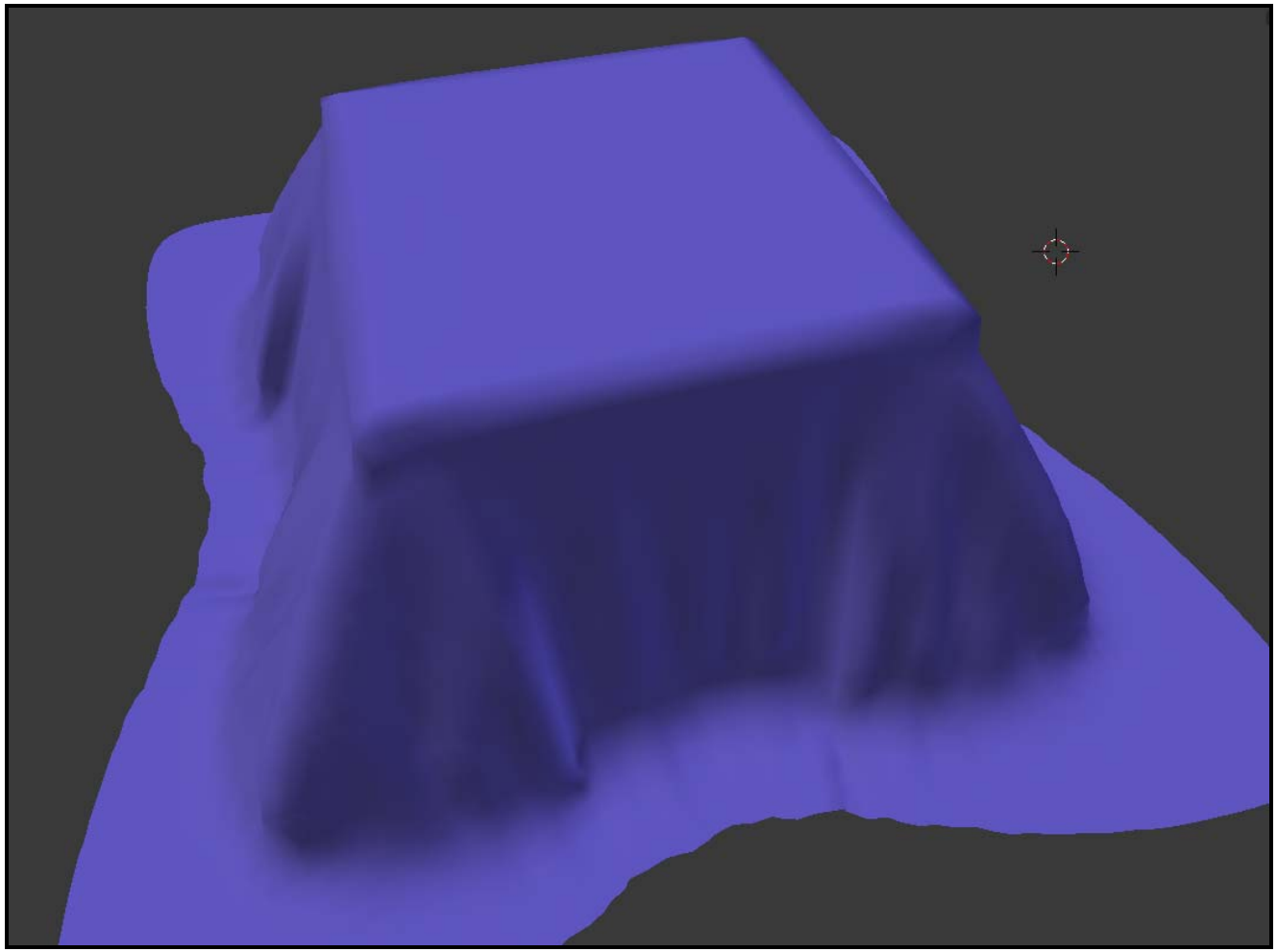


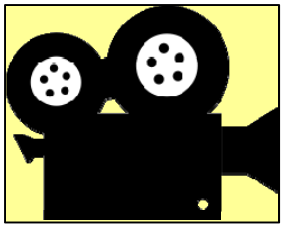
Cloth Examples





Cloth Example



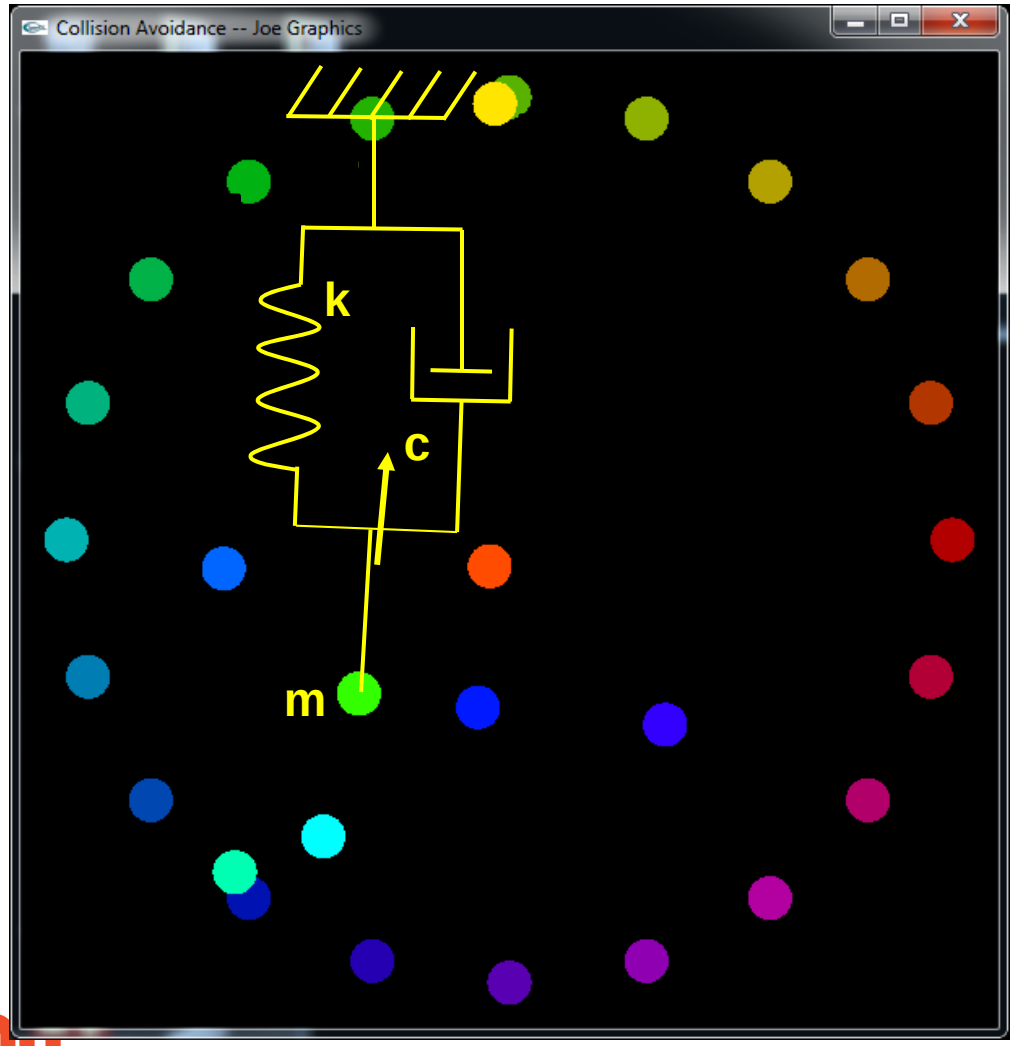


cloth.mp4

Cloth Example

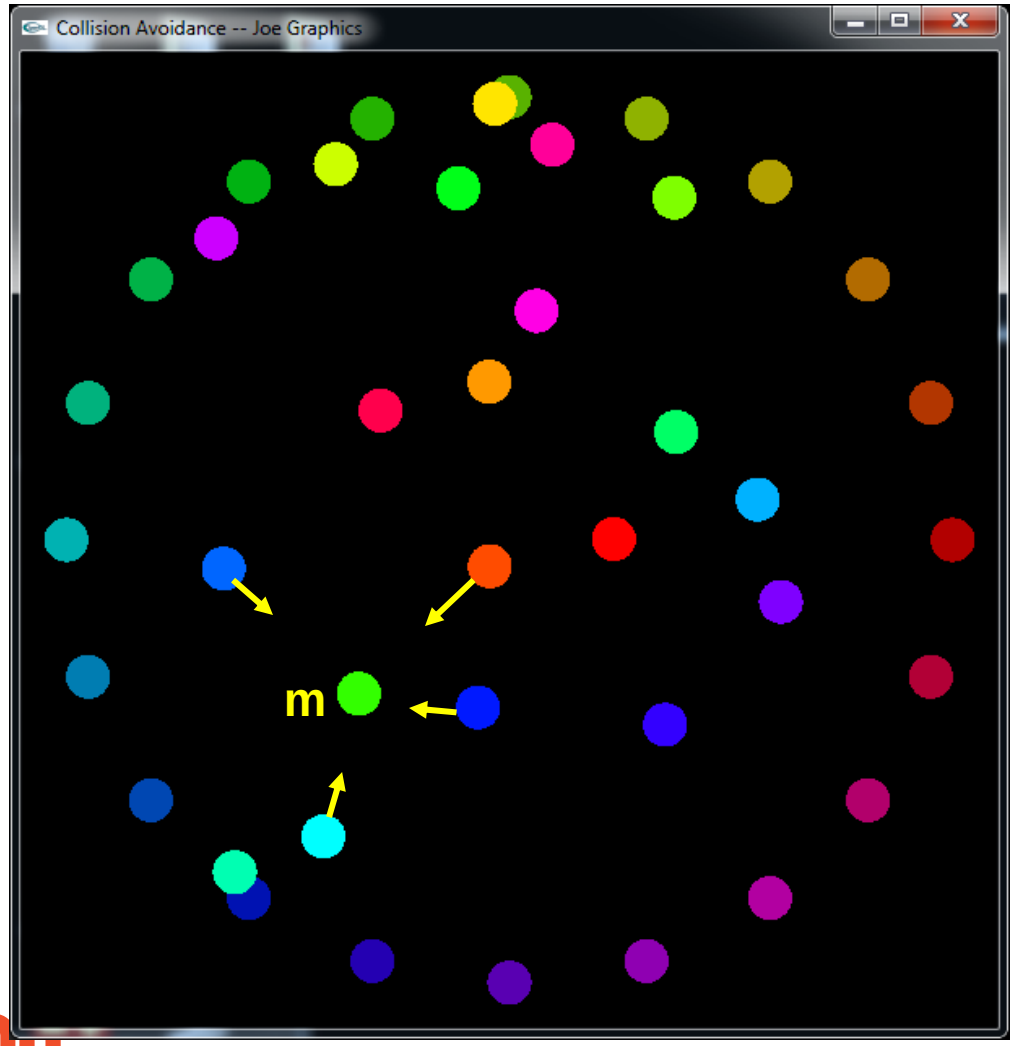
Pixar

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



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

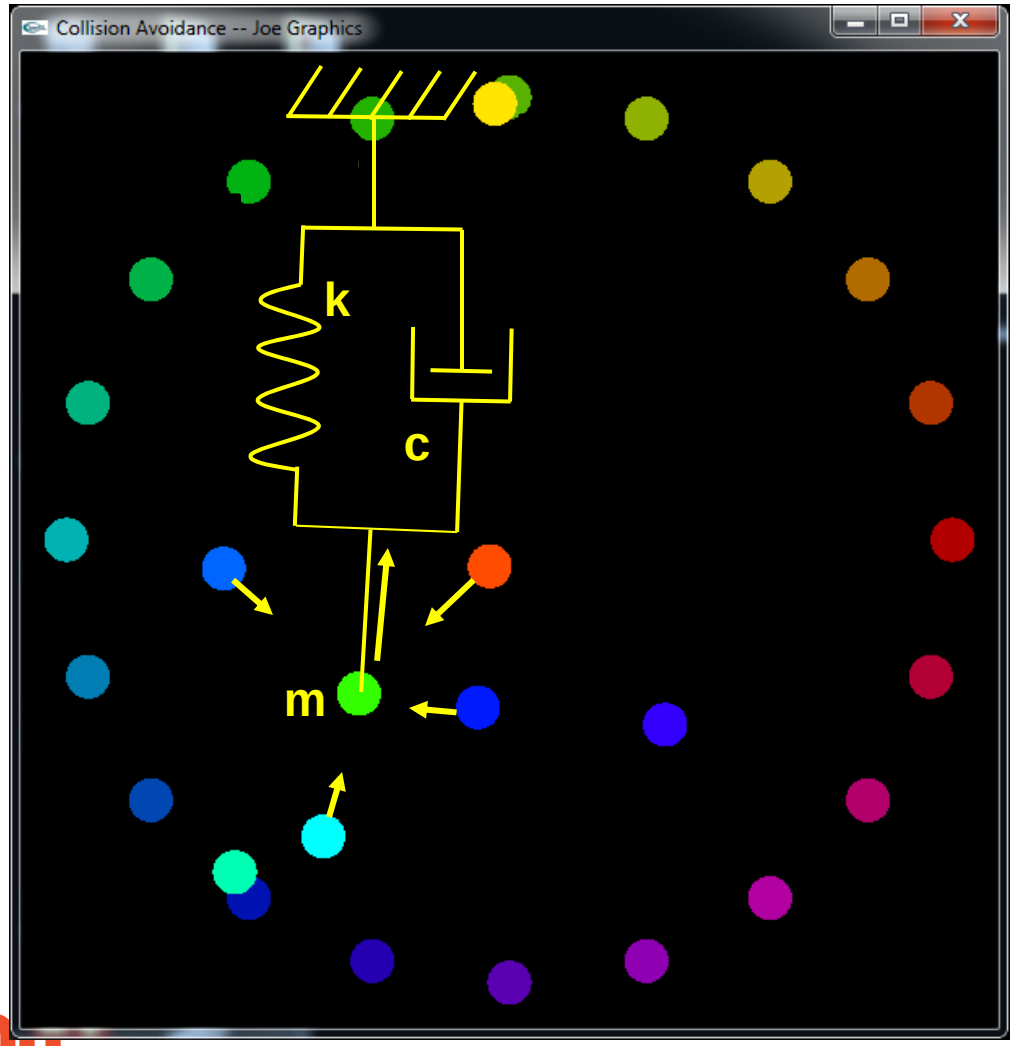
Repulsion Coefficient

$$F_{repulsive} = \frac{C_{repulse}}{d^{Power}}$$

Distance between the boundaries of the 2 bodies

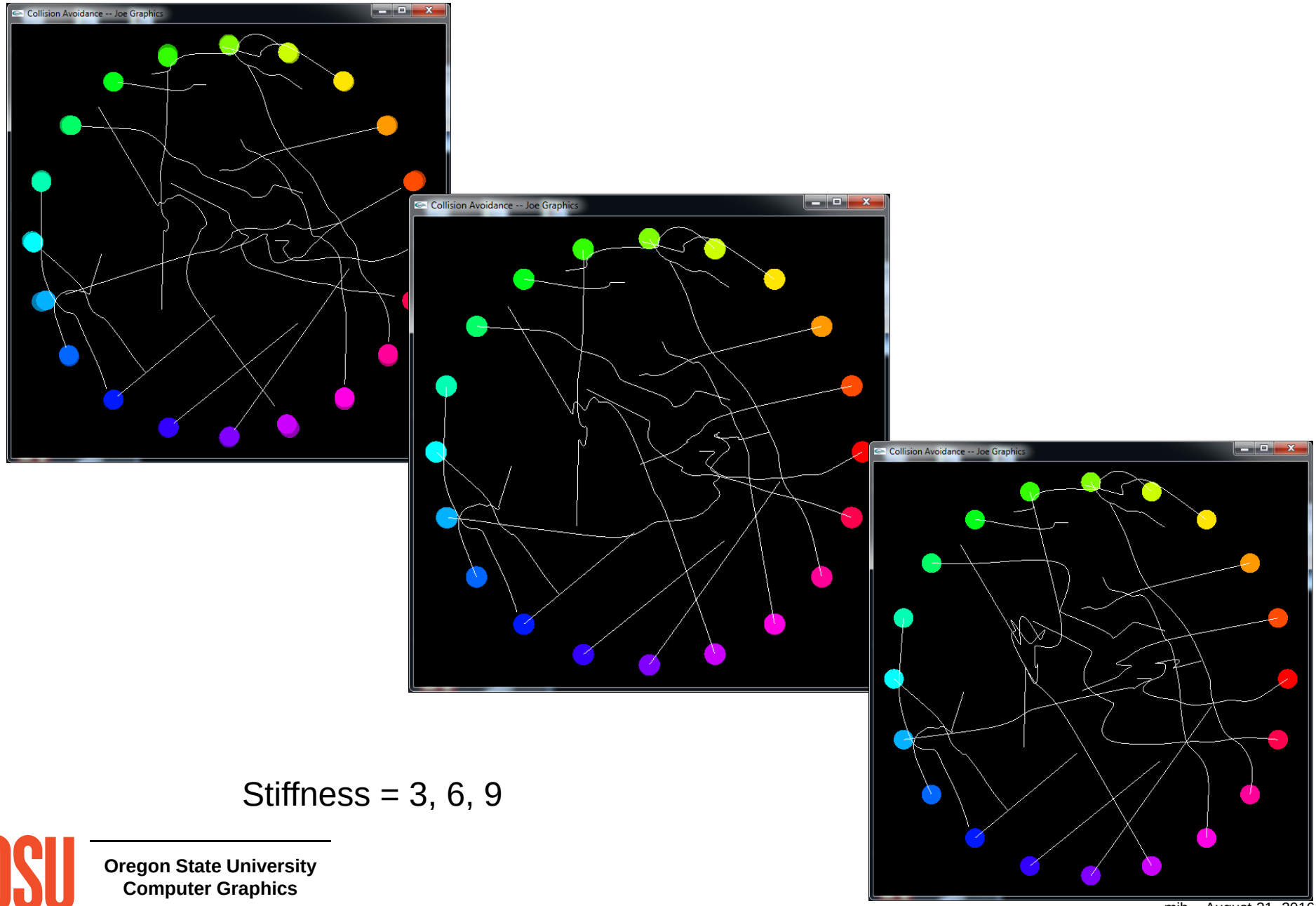
Repulsion Exponent

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



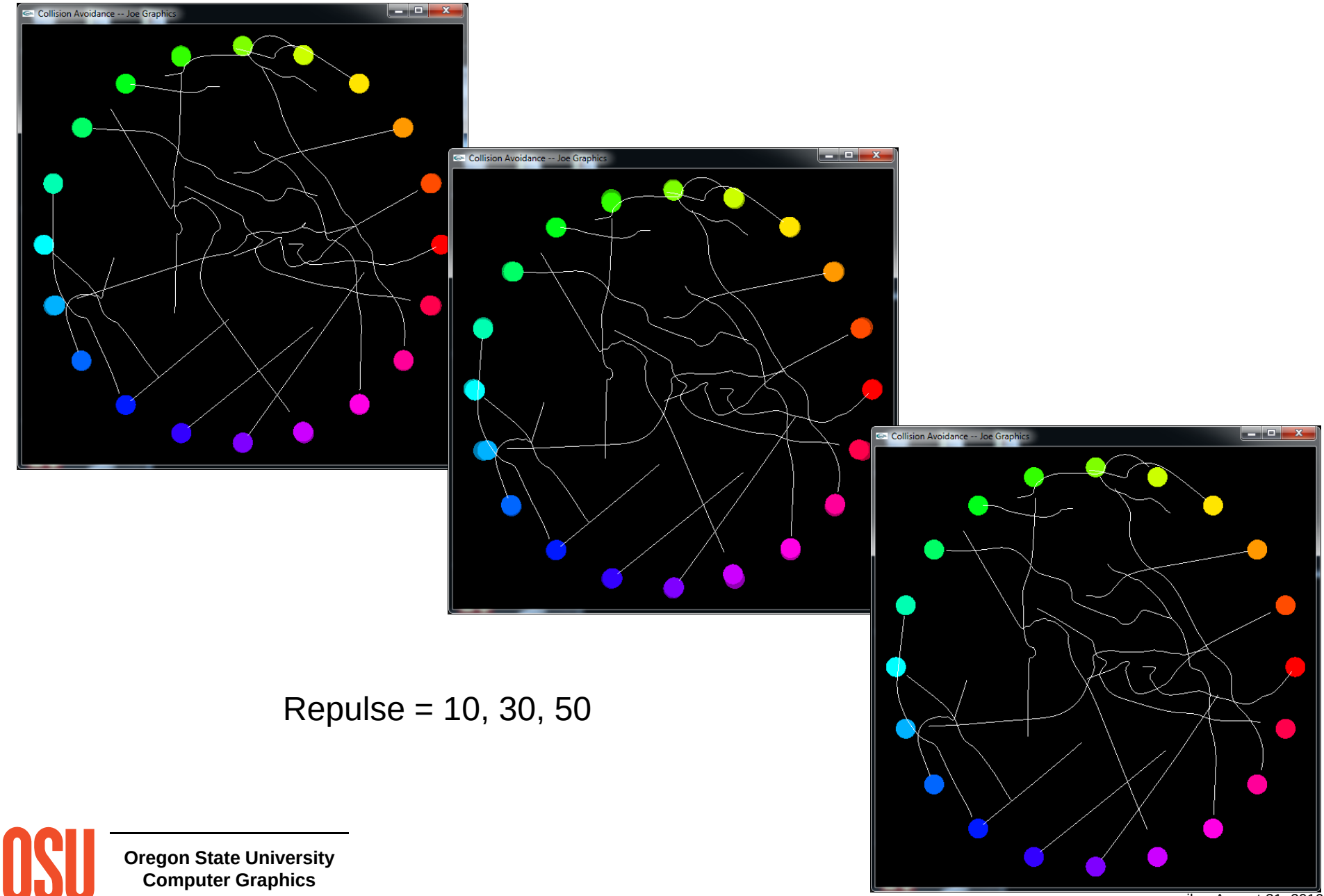
$$m\ddot{x} + c\dot{x} + kx = \sum F$$

Increasing the Stiffness



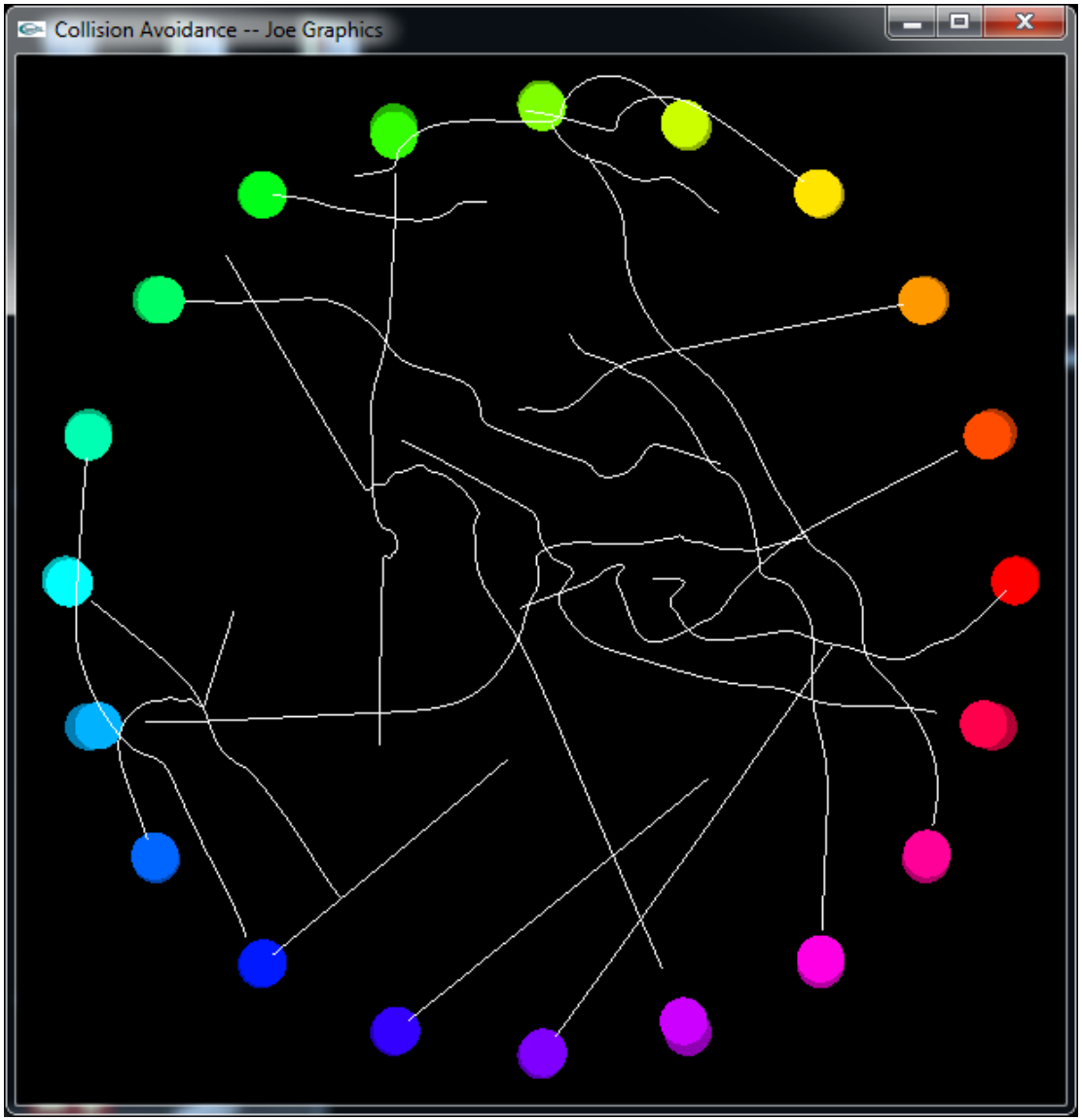
Stiffness = 3, 6, 9

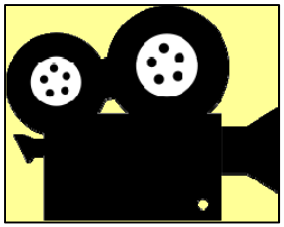
Increasing the Repulsion Coefficient



Repulse = 10, 30, 50

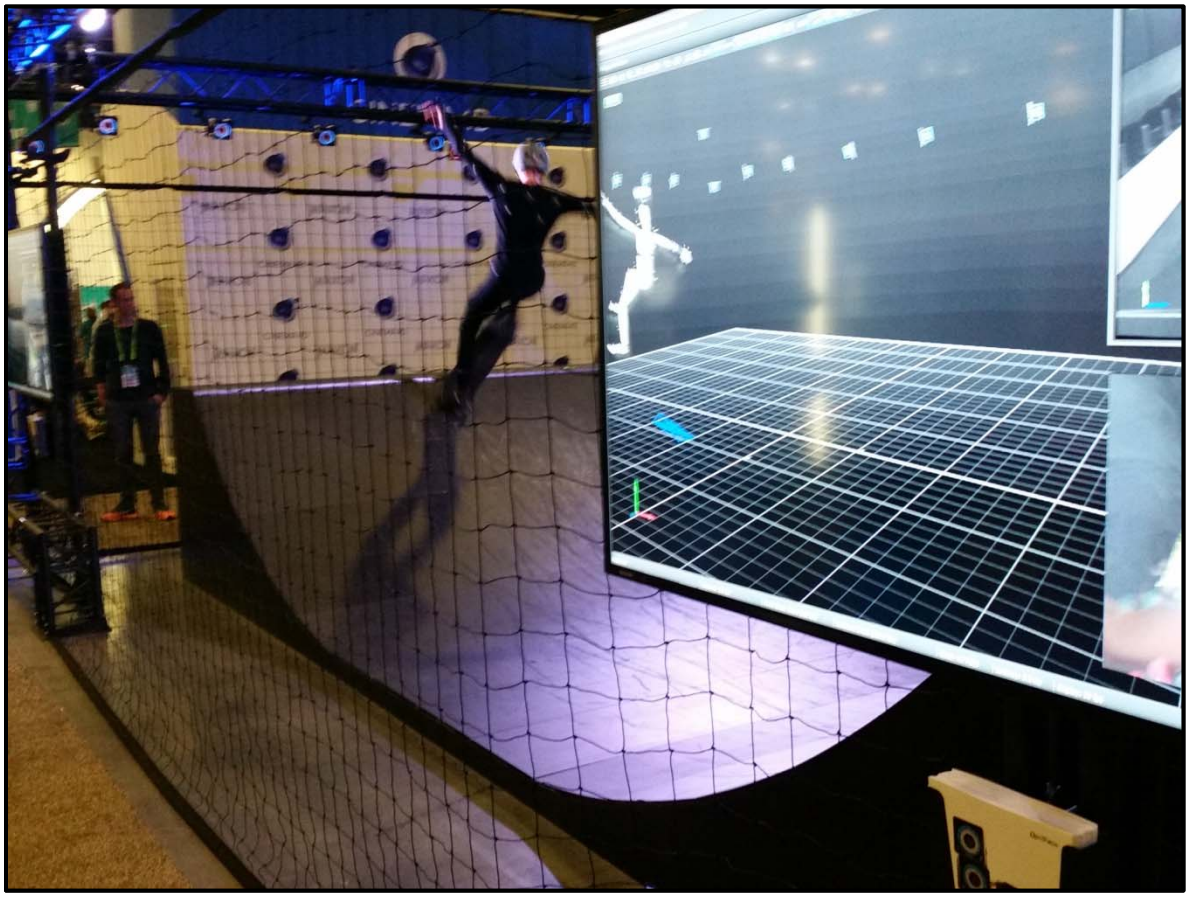
Functional Animation





avoid.mp4

Motion Capture as an Input for Animation



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

Card Trick

Pixar Animated Shorts