Rigid Body Simulation

CS-116B: Computer Graphics Algorithms
Spring 2018

Rigid Body Simulation

Rigid body simulations advantages:

- Simulations are computed quickly (p. 45).
- Low memory footprint (p. 45).

Why?

- Rigid bodies are non-deformable (p. 45).
- The rigid body can be represented “by a set of point masses connected by springs of infinite stiffness” (p. 45).

Source: *Real Time Physics Class Notes* by Matthias Müller, Jos Stam, Doug James, and Nils Thürey.

Rigid Bodies: linear and angular motion

In linear motion:

- A rigid body can be represented by “...a single particle at the center of mass with the total mass of the body” (p. 46).

For angular motion:

- “all the particles [that comprise a rigid body] have to have the same angular velocity” (p. 45).

Source: *Real Time Physics Class Notes* by Matthias Müller, Jos Stam, Doug James, and Nils Thürey.

Rigid Bodies: four states

Rigid bodies are defined by four qualities:

- “the position of the center of mass” (p. 47).
- “the orientation represented by a rotation matrix” (p. 47).
- “the linear velocity of the center of mass” (p. 47).
- “the angular velocity about the center of mass.” (p. 47).

Source: *Real Time Physics Class Notes* by Matthias Müller, Jos Stam, Doug James, and Nils Thürey.

Example: Billiard balls

Consider billiard balls: a cue ball strikes another ball.

- Both balls have same weight.
- Both balls are the same size.
- Both balls have the same hard surface (rigid).
- The collision is nearly perfectly elastic.

In a perfectly elastic collison, there’s no loss in kinetic energy before and after the collision.

- Momentum is conserved

For Further Reading

The Physics of Billiards. http://www.real-world-physics-problems.com/physics-of-billiards.html

Physics for Game Developers (pp. 378-400).