Rigid Body Simulation

PBS Final Project

Ivan Waldboth

Mathias Hölzl

Florian Tischler

Goals

- 2D rigid body simulation
- Real-time
- Visualization
- Dynamic and static objects
- Simple Objects (spheres, boxes)
- Editable Environment (adding, moving objects)

- Stretch goals
  - Debug visualization
  - Arbitrary convex objects
  - Kinematic objects

Goals

- ✓ • 2D rigid body simulation (partial)
- ✓ • Real-time
- ✓ • Visualization
- ✓ • Dynamic and static objects
- ✓ • Simple Objects (spheres, boxes)
- ✓ • Editable Environment (adding, moving objects)

- • Stretch goals
  - ✓ • Debug visualization
  - ✓ • Arbitrary convex objects
  - ✗ • Kinematic objects

Implementation

- Semi-implicit Euler integrator
- Simple collision detection
  - Inside-outside test for points
  - Line-line intersection test for finding contact point
  - $O(n^2)$

- Impulse-based collision resolution (lecture)
  - Additionally
    - Friction
    - Position correction
    - Slop

- OpenMP parallelization

Problems

- Tunneling
  - Needs continuous collision detection

- Instabilities due to no resting contact resolving
  - Warm starting
  - Keep contacts of previous iteration and compare with new ones
    - If new contact point close to old one
    - Keep previous contact
    - Mark it persisent
    - At resolution use previous impulse

- Collision detection issues
  - Expensive (O(n²)
  - Points not detected when lying on edge/point

Demo