Topics in Computer Animation
Animation Techniques

• Artist-Driven animation
  – The artist draws some frames (keyframing)
  – Usually in 2D
  – The computer generates intermediate frames using interpolation
  – The old way...
  – Better than flipbook. No need to draw every frame
  – Still a lot of work...
Animation Techniques

• Data-Driven animation
  – Motion capture from the real world (data capture)
  – Mapping motion from the actor to the virtual character (retargeting)
  – Typically requires markers
  – Markerless? Doable but not easy
  – Synthesize different animations from a data set?
Animation Techniques

• Physically based animation
  – Solving physics equations over time
  – Needs more computational cost
  – Can interact with users (so useful in game)
  – We will study more about this...
Animation Content

• Character animation
  – Character motion planning, synthesis, control
  – Represented in skeleton
  – Retargeting from one character to another, especially if they are very different
  – Usually data-driven
  – Can be physically based
    (by computing the body weights, joint forces, ...)
Animation Content

• Passive animation
  – Everything else that cannot move itself
  – Simulated by physics
Simulation Techniques

• Particle based simulation
  – Just a set of independent particles
  – Can run in parallel (suitable for graphics processors)
  – Has no geometric structure
  – Easy to create, easy to maintain
  – Widely used in games
  – Good for objects without fixed shapes
  – Difficult to obtain the object surface
    (unfriendly to rendering)
Simulation Techniques

- Particle based simulation
  - Example 1: Flame in game engines
Simulation Techniques

• Particle based simulation
  – Example 1: Flame in game engines
  – Example 2: High-quality water animation
    based on Smoothed Particle Hydrodynamics (SPH)
Simulation Techniques

• Particle based simulation
  – Example 1: Flame in game engines
  – Example 2: High-quality water animation based on Smoothed Particle Hydrodynamics (SPH)
  – Example 3: Flocking and crowd
Simulation Techniques

• Particle based simulation
  – Example 1: Flame in game engines
  – Example 2: High-quality water animation based on Smoothed Particle Hydrodynamics (SPH)
  – Example 3: Flocking and crowd
  – Example 4: Snow
Simulation Techniques

• Mesh based simulation
  – Represents the object using meshes
  – Easy to create shape details
  – Easy to extract the surfaces (rendering friendly)
  – Rigid body, soft body (deformable body)
  – Needs to handle collisions... A difficult problem
    (Many games do not consider detailed collisions.)
  – Remeshing is also difficult
    (for example, in fracture animation)
  – Numerical stability problem
Simulation Techniques

• Mesh based simulation
  – Example 1: Cloth animation
    (can be done only in meshes)
Simulation Techniques

• Mesh based simulation
  – Example 1: Cloth animation
    (can be done only in meshes)
  – Example 2: water animation
    (highly detailed, less computationally expensive)
Simulation Techniques

• Mesh based simulation
  – Example 1: Cloth animation
    (can be done only in meshes)
  – Example 2: water animation
    (highly detailed, less computationally expensive)
  – Example 3: Viscoelastic fluid
Simulation Techniques

• Mesh based simulation
  – Example 1: Cloth animation  
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  – Example 2: water animation
    (highly detailed, less computationally expensive)
  – Example 3: Viscoelastic fluid
  – Example 4: Fracture
Simulation Techniques

• Mesh based simulation
  – Example 1: Cloth animation (can be done only in meshes)
  – Example 2: water animation (highly detailed, less computationally expensive)
  – Example 3: Viscoelastic fluid
  – Example 4: Fracture
  – Example 5: Soft body
Simulation Techniques

• Volume-based simulation
  – Defines the object in a volume
  – No need to handle collisions
  – Nor Remeshing
  – Surface extraction is a problem
    (not difficult, but takes time)
  – Cannot work easily in real time, but can be in very high-quality
Simulation Techniques

• Volume-based simulation
  – Example 1: Oscar-winning smoke animation
  – Example 2: Fluid animation
  (Needs an additional method to represent water surface: the Level set method)
Simulation Techniques

• Volume-based simulation
  – Example 1: Oscar-winning smoke animation
  – Example 2: Fluid animation
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# Simulation Topics Summary

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