An Overview of Physically Based Modeling

References
We started with some detailed notes on integration and on setting up and simulating particle systems. These notes can be found in the third reference below. The other references may also be of interest! Many of the movies later in these slides can be found online, if you would like to see them again. (Search for the web pages of the authors.)

  – http://portal.acm.org/citation.cfm?id=357320601854277ACM&CFID=1285824576&CToken=7984956

  – http://portal.acm.org/citation.cfm?id=97302601854277ACM&CFID=1285824576&CToken=7984956

• A. Witkin, D. Baraff, M. Kass: Physically-Based Modeling, SIGGRAPH tutorial course notes. 2001

• Partial slide credit: Thomas Funkhouser
More Particle Systems

- With some adjustments to the particle and spring-mass systems we have see so far, we can handle
  - large numbers of rigid bodies
  - cloth
  - hair and fur

Handling Lots of Collisions

- B. Mirtich, Time-warp technique
  (SIGGRAPH 2000)

Figure 1: Avalanche: 300 rocks tumble down a mountainside.
Guendelman, Bridson, and Fedkiw (Stanford), SIGGRAPH 2003

Handling Lots of Collisions

James and Pai, SIGGRAPH 2004
Cloth

Bridson, Fedkiw, and Anderson, SIGGRAPH 2002

Baraff and Witkin, SIGGRAPH 1998

Cloth

stable and responsive cloth….

…with buckling

Choi and Ko, SIGGRAPH 2002
Cloth

Clothing with wrinkles
Bridson, Marino, and Fedkiw (Stanford), SCA 2003

Dealing with self-intersection
Baraff, Witkin, and Kass (Pixar), SIGGRAPH 2003

Estimating Cloth Parameters from Video
Hair, Fur and other Strands

Visualization of Hair-Hair Interactions

Static Links are Colored in Red

Short Hair in Wind

Chang, Jin, and Yu, SCA 2002
Beyond Particle Systems

- Many natural phenomena are based on approximations of the Navier-Stokes equations characterizing fluid flow
  - water
  - smoke
  - steam
  - fire
  - explosions!

Smoothed Particles

Stam & Fiume, Turbulent Wind Fields for Gaseous Phenomena, 1993
Fluids

Mark Carlson, Peter J. Mucha and Greg Turk. SIGGRAPH 2004

interaction with rigid bodies

Raanan Fattal and Dani Lischinski. SIGGRAPH 2004

directable smoke

Antoine McNamara, Adrien Treuille, Zoran Popović, Jos Stam. SIGGRAPH 2004
directable fluid

Goktekin, Bargteil, O'Brien. SIGGRAPH 2004
goop

Explosions

Feldman, O'Brien, and Arikan (Berkeley), SIGGRAPH 2003

Explosions
Finite Element Models

- Fracture
- Deformation

Fracture

"Graphical Modeling and Animation of Brittle Fracture"
James F. O'Brien
Jessica K. Hodgins
www.cis.gatech.edu/animation/Fracture

© 1999, Georgia Institute of Technology
Multiresolution Simulation

Debunne, Desbrun, Cani, and Barr, SIGGRAPH 2001

Multiresolution Simulation

Capell et al., SCA 2002
Multimodal Aspects: Sound

FOLEY AUTOMATIC:
Physically-based Sound Effects for Interactive Simulation and Animation

van den Doel, Kry, and Pai, SIGGRAPH 2001

Appearance from Video