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.)

- W. T. Reeves, Particle Systems - a Technique for Modeling a Class of Fuzzy Objects, ACM Transactions on Graphics, 2(2), pp. 91-108, 1983.
  - http://portal.acm.org/citation.cfm?id=357320&dl=ACM&coll=portal&CFID=12858257&CFTOKEN=79986367

- Karl Sims, Particle animation and rendering using data parallel computation, ACM SIGGRAPH Computer Graphics, v.24 n.4, p.405-413, Aug. 1990
  - http://portal.acm.org/citation.cfm?id=97923&dl=ACM&coll=portal&CFID=12858257&CFTOKEN=79986367

- A. Witkin, D. Baraff, M. Kass: Physically-Based Modeling, *SIGGRAPH tutorial course notes.* 2001
  - http://www.pixar.com/companyinfo/research/pbm2001/

- 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

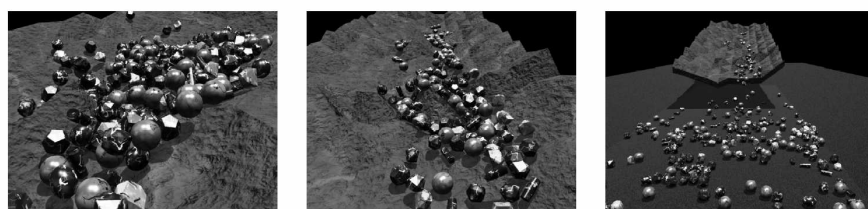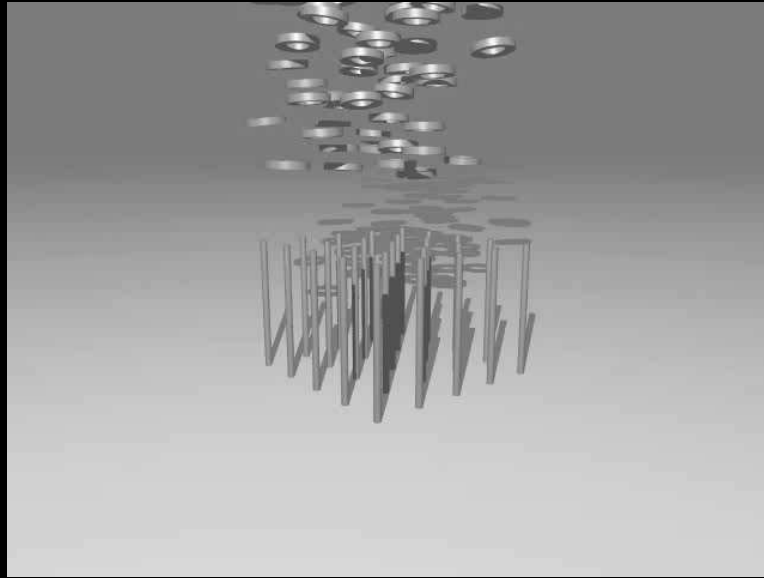- B. Mirtich, Time-warp technique
(SIGGRAPH 2000)

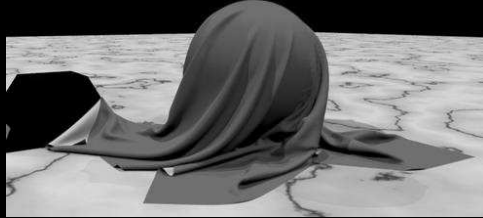Figure 1: *Avalanche:* 300 rocks tumble down a mountainside.

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

Kiran S. Bhat, Christopher D. Twigg, Jessica K. Hodgins, Pradeep K. Khosla, Zoran Popovic and Steven M. Seitz. *SIGGRAPH* 2003.

Hair, Fur and other Strands

Hair, Fur and other Strands

Visualization of
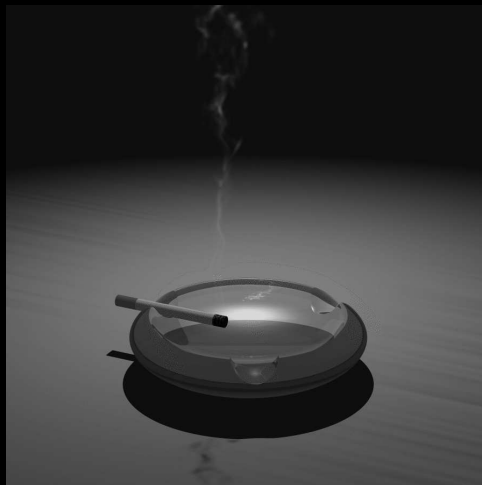Hair-Hair
Interactions

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

interaction with rigid bodies

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

directable smoke

Raanan Fattal and Dani Lischinski. SIGGRAPH 2004

directable fluid

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

goop

Goktekin, Bargteil, O'Brien. SIGGRAPH 2004

Explosions

Explosions

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

Finite Element Models

- Fracture
- Deformation

Fracture

"Graphical Modeling and Animation of Brittle Fracture"
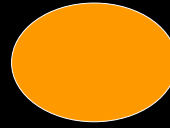
James F. O'Brien
Jessica K. Hodgins

www.cc.gatech.edu/animation/Fracture

(C) 1999, Georgia Institute of Technology

Multiresolution Simulation

Debunne, Desbrun, Cani, and Barr, SIGGRAPH 2001

Multiresolution Simulation

Capell et al., SCA 2002

Multimodal Aspects: Sound

FOLEYAUTOMATIC:

Physically-based
Sound Effects for
Interactive Simulation
and Animation

van den Doel, Kry, and Pai, SIGGRAPH 2001

Appearance from Video

Kiran S. Bhat, Steven Seitz, Jessica Hodgins and Pradeep Khosla.
SIGGRAPH 2004.