

15-462 Computer Graphics I

Lecture 17

An Overview of Physically Based Modeling

October 30, 2003

Doug James

Carnegie Mellon University

<http://www.cs.cmu.edu/~djames/15-462/Fall03>

Announcements

- Midterm: Make sure you received 7/7 on Q4.3.
- Particles assignment due Friday at midnight.

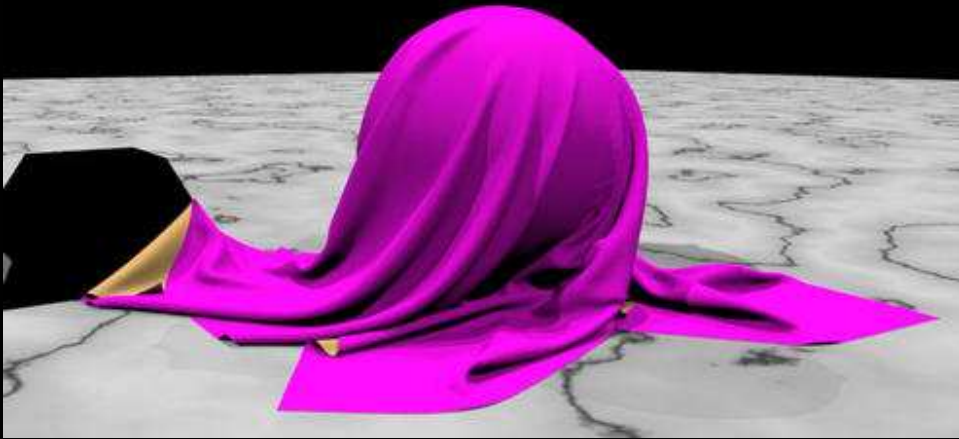
Motivation



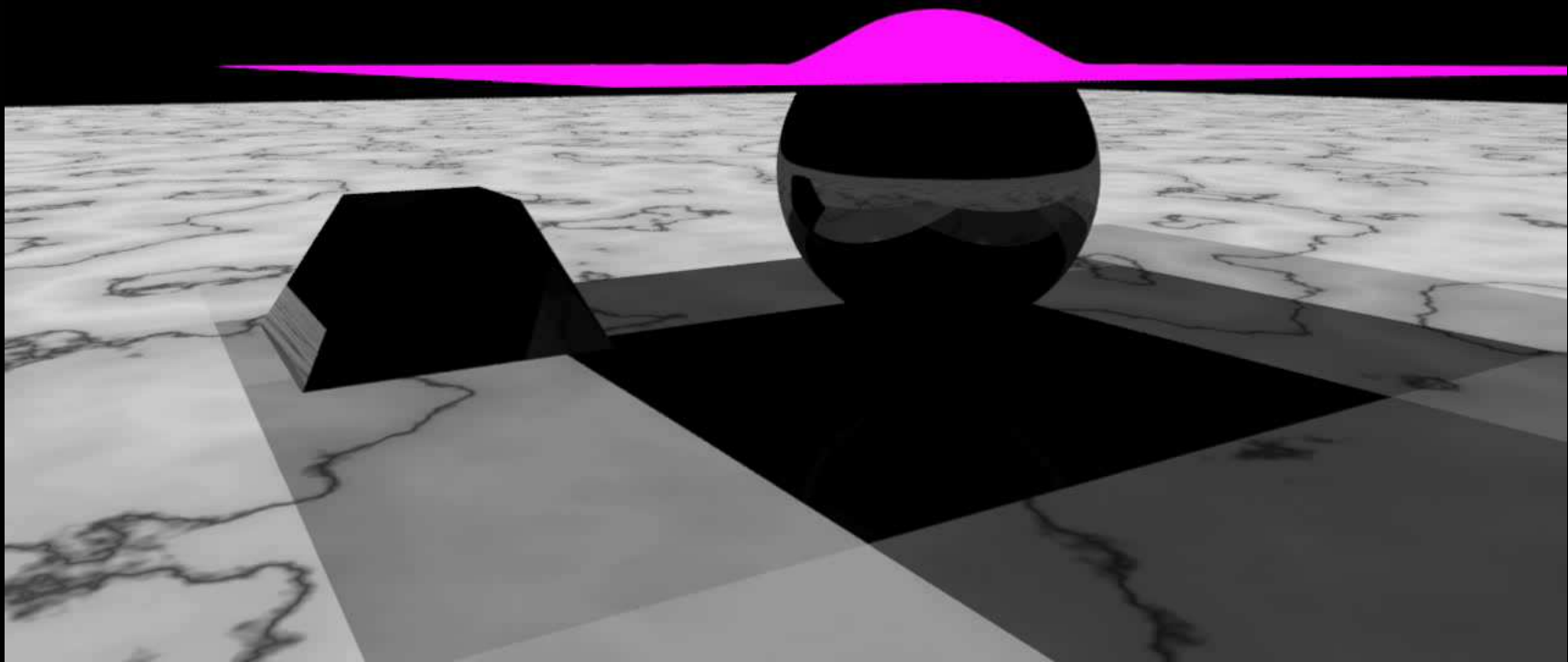
Physically Based Modeling (PBM)

- Particles are just the tip of the iceberg
- Graphics wants approximations of all physical phenomena with visual relevance
- Major PBM research areas:
 - Core: physics modeling + rendering
 - Real-time algorithms
 - Interactive physics; multimodal
 - Precomputation techniques

Cloth



Cloth

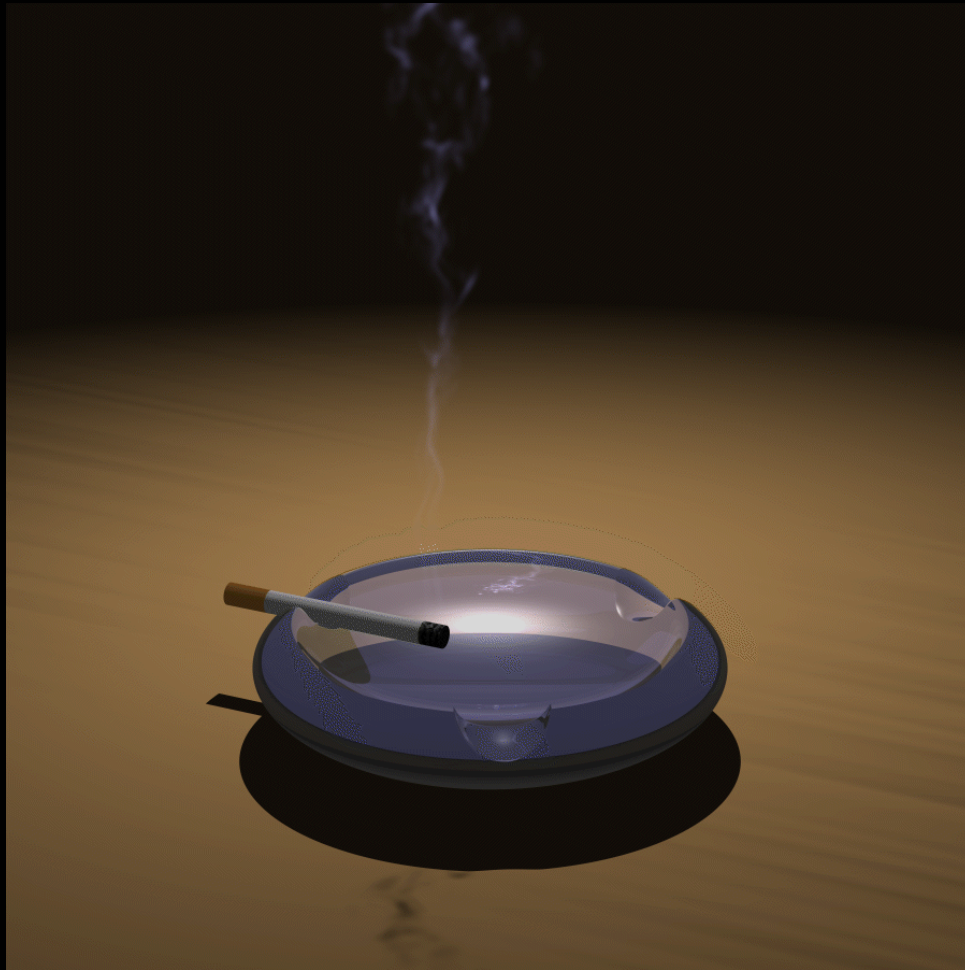


10/16/2003

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Smoothed Particles



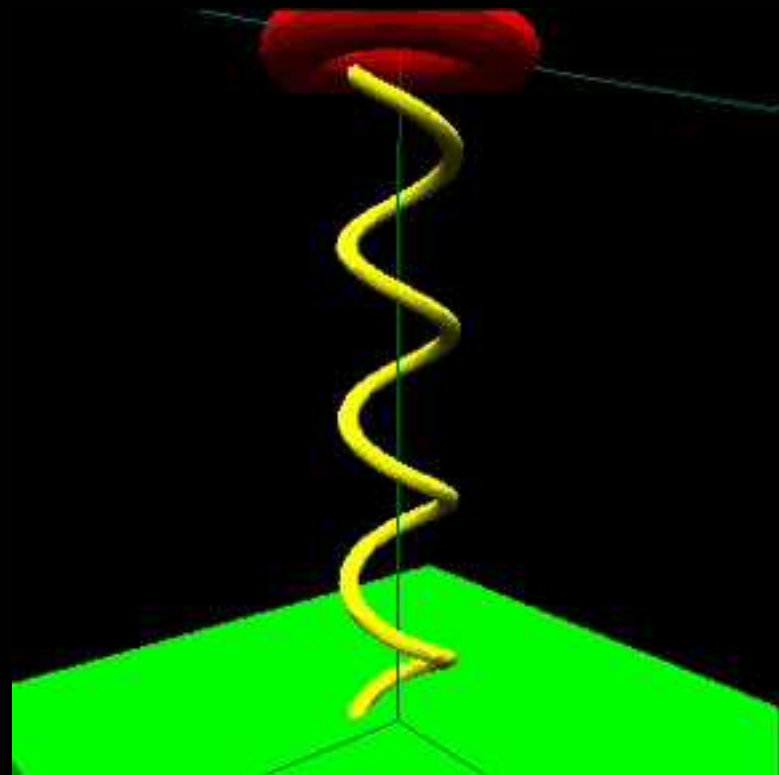
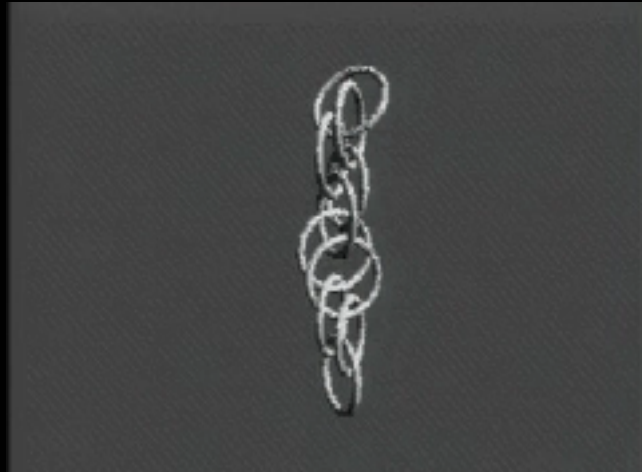
Stam & Fiume, Turbulent Wind Fields for Gaseous Phenomena, 1993



Rigid Bodies



Collision Detection



Handling Lots of Collisions

- B. Mirtich, Time-warp technique

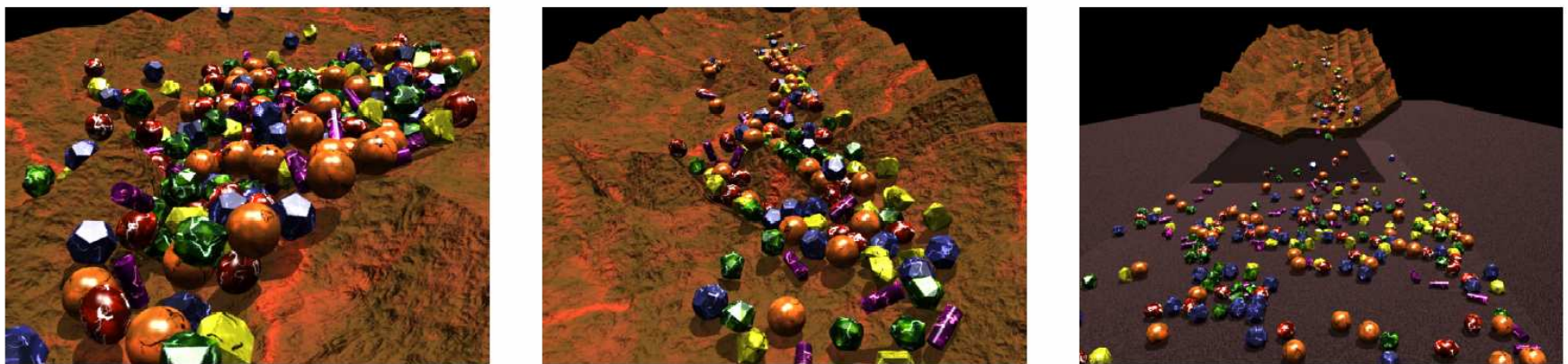
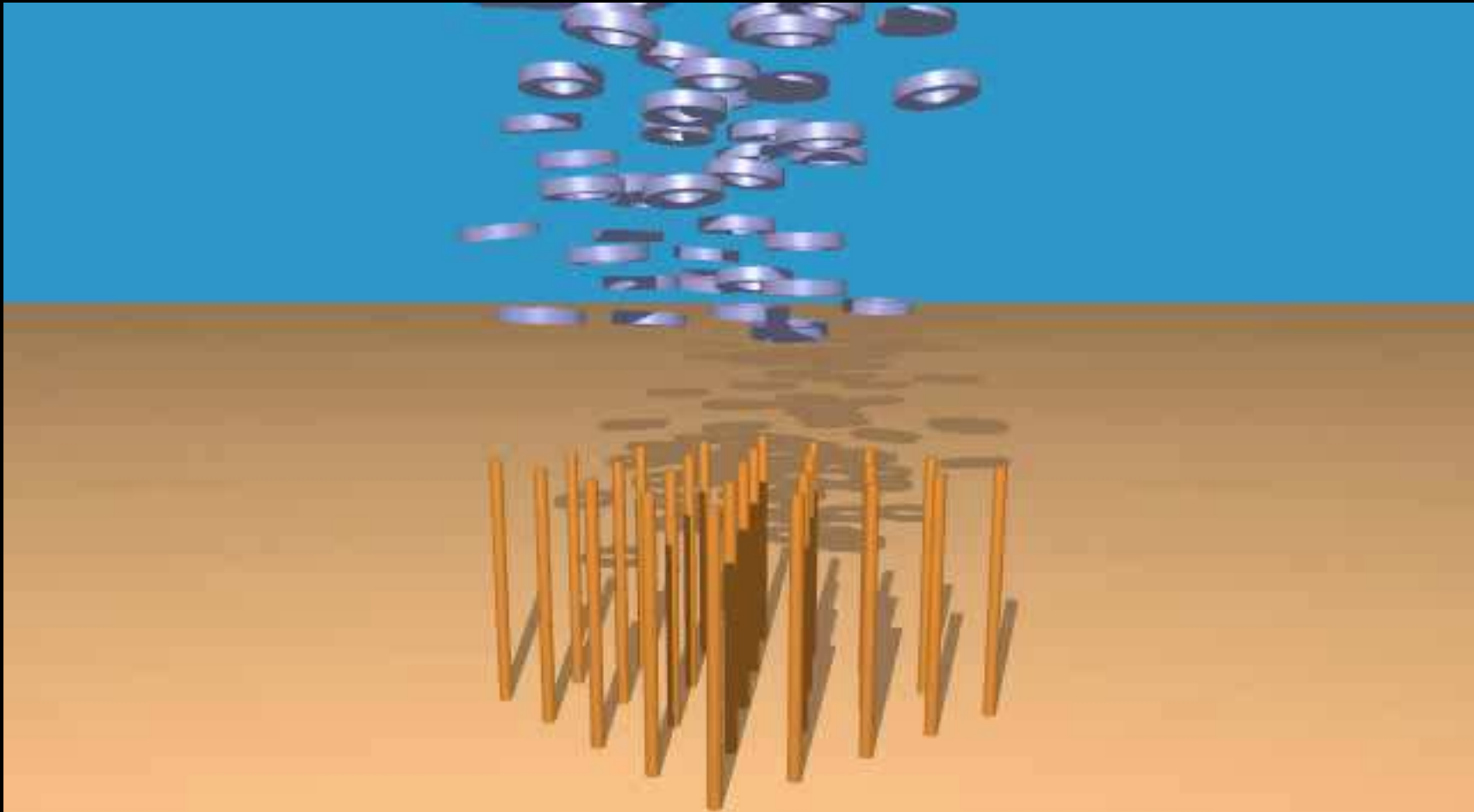
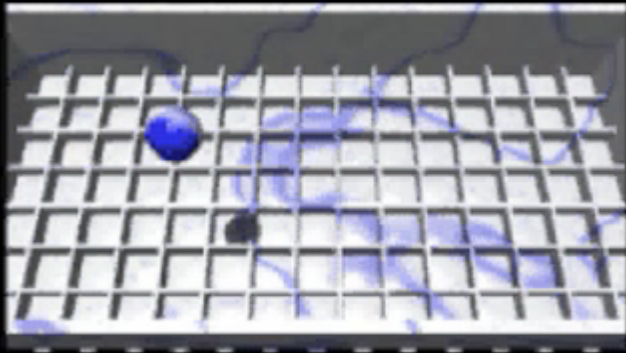


Figure 1: *Avalanche*: 300 rocks tumble down a mountainside.



Guendelman, E., Bridson, R. and Fedkiw, R.,
"Nonconvex Rigid Bodies with Stacking",
SIGGRAPH 2003, ACM TOG 22, 871-878 (2003).

Animator Control



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

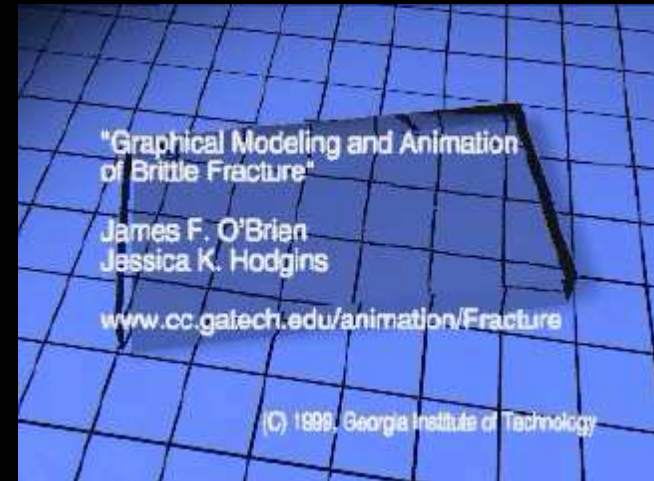
Fracture

"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

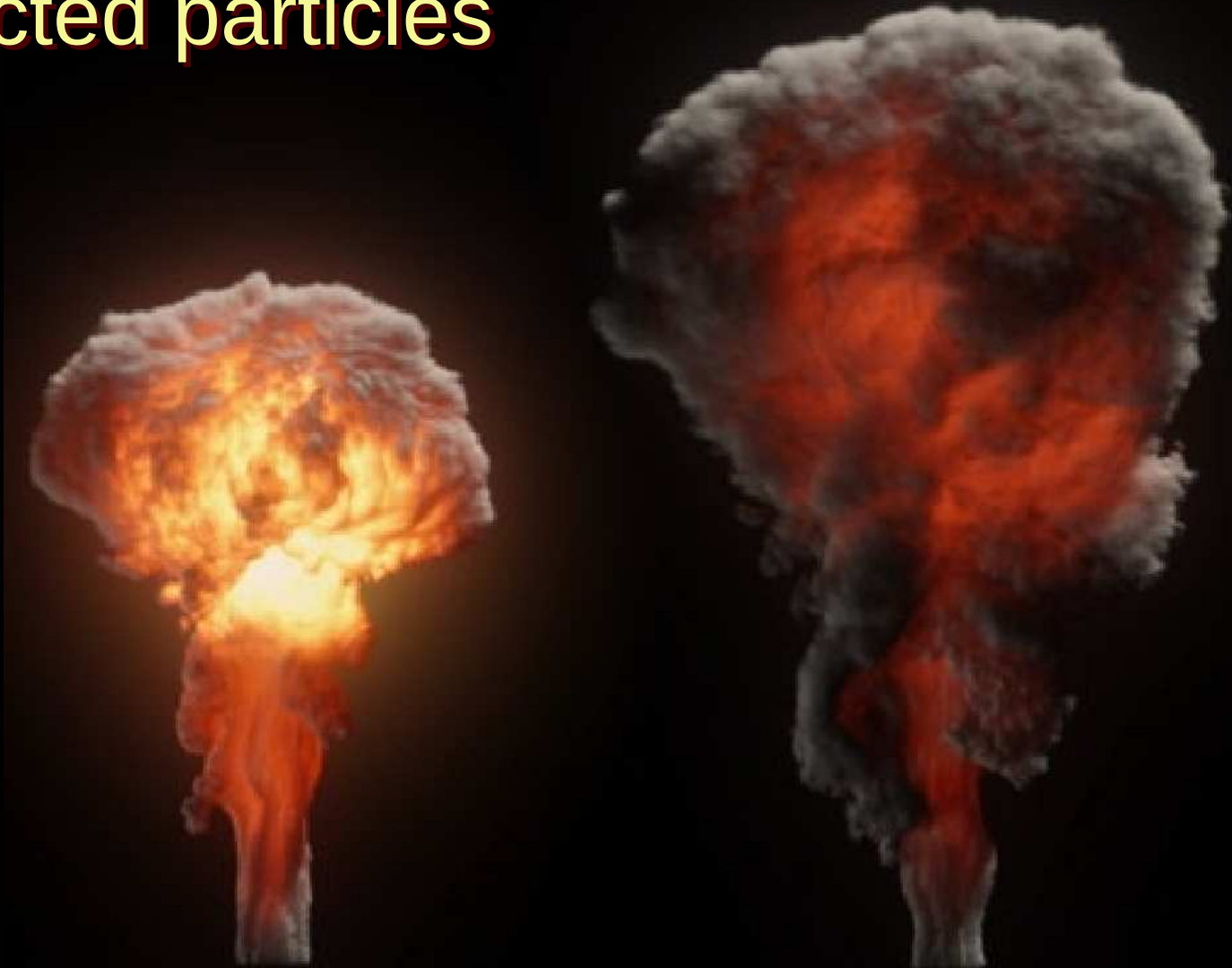


Fracture

Smoke



Advected particles



Fire



Fire



Fluids

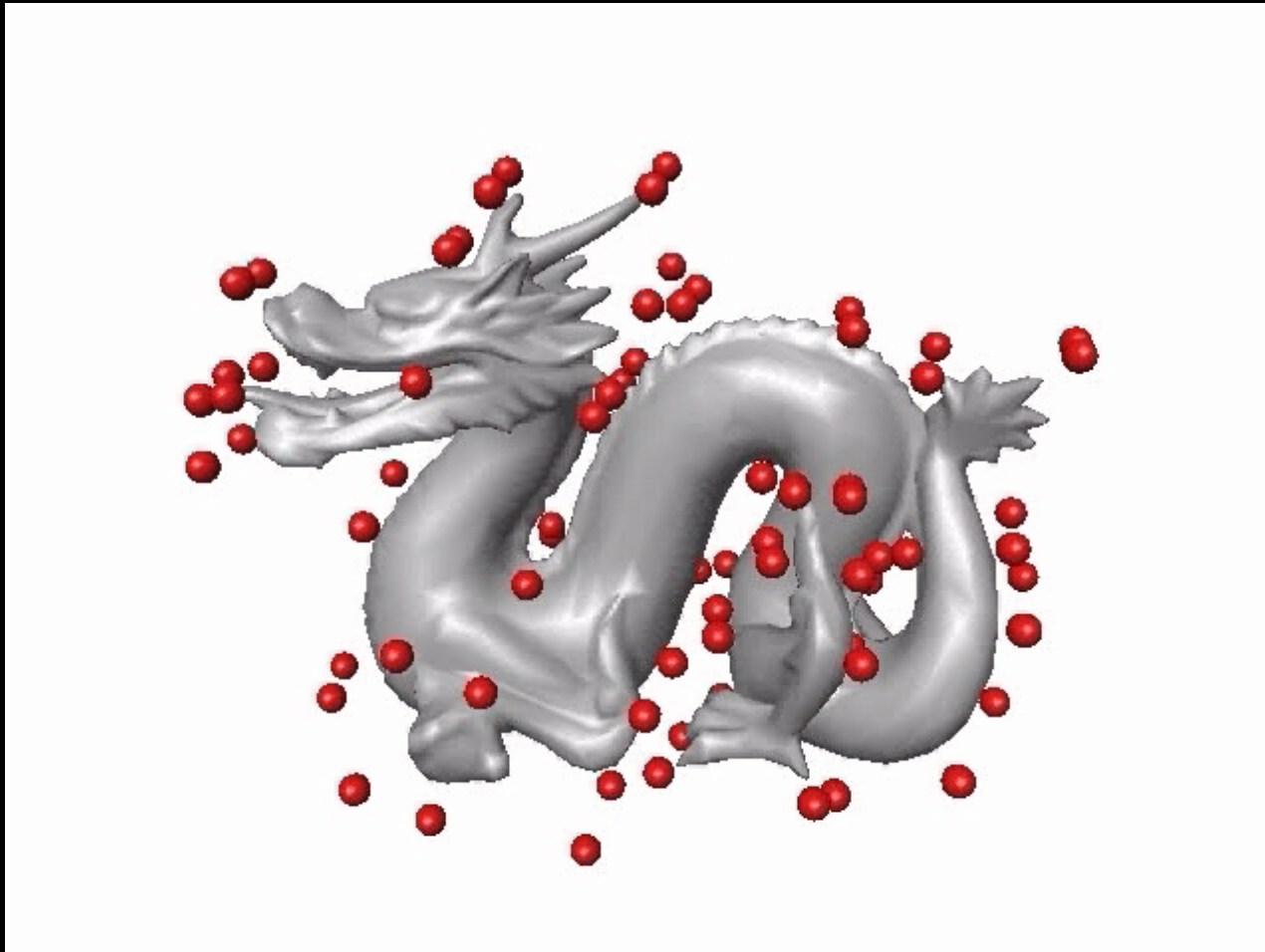
Multiresolution Simulation

Dynamic Real-Time
Deformations using
Space-Time Adaptive
Sampling

paper #235

Multiresolution Simulation

Multiresolution Simulation

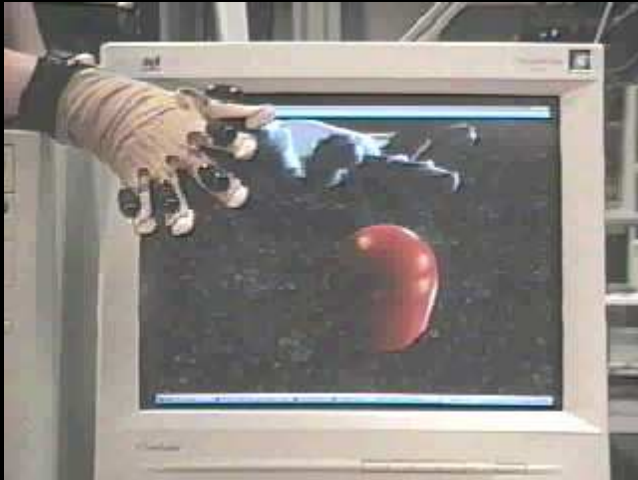


Multimodal Aspects: Sound

FOLEYAUTOMATIC:

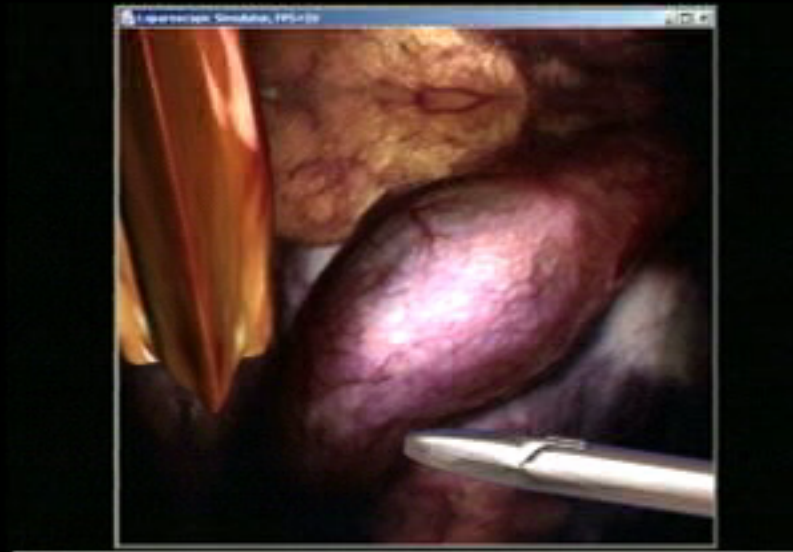
Physically-based
Sound Effects for
Interactive Simulation
and Animation

Multimodal Aspects: Haptic Interfaces



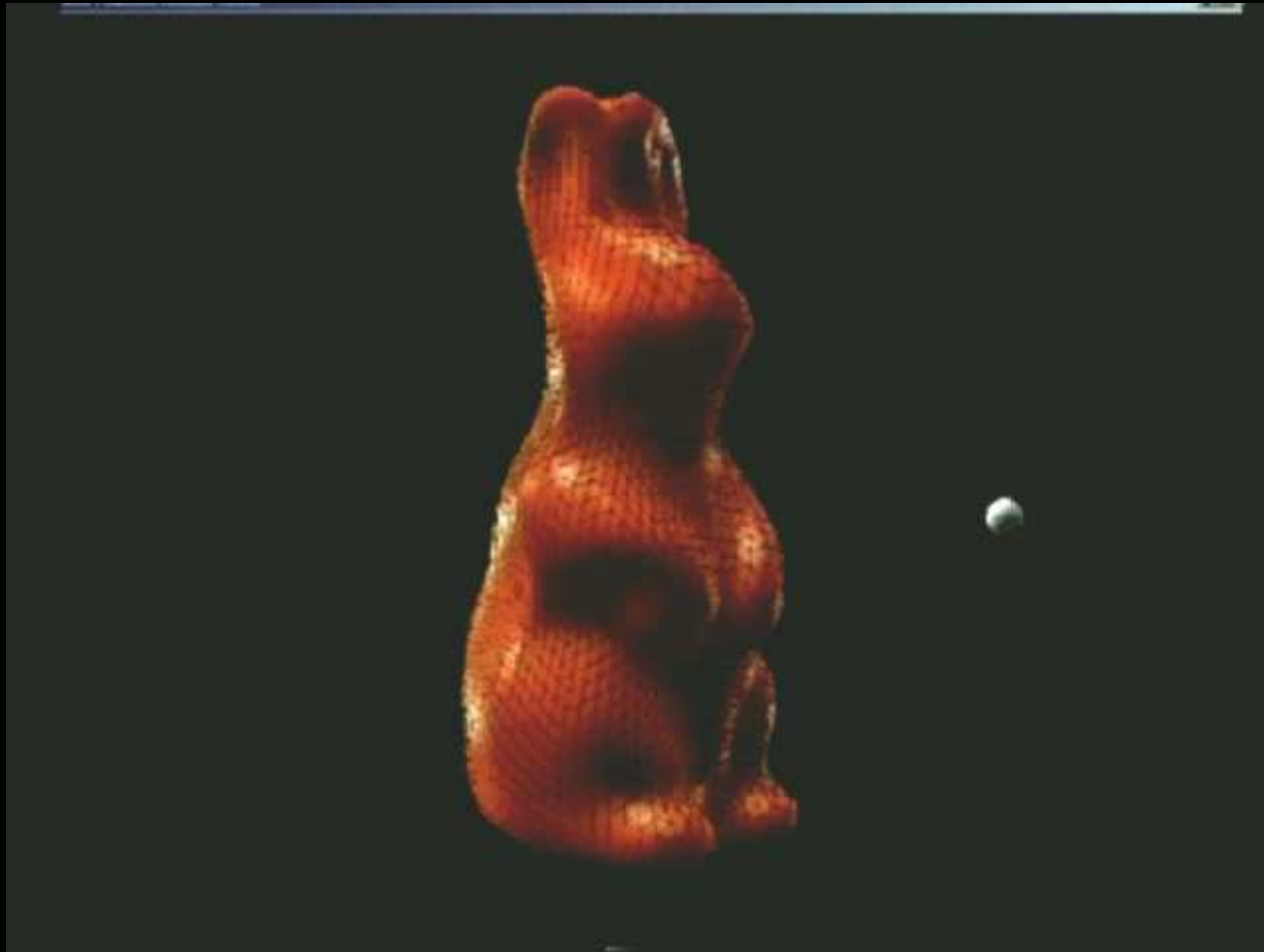
Haptic Interaction with
Linear Elastic Models

Doug L. James
Dinesh K. Pai
Univ. British Columbia
April 2000

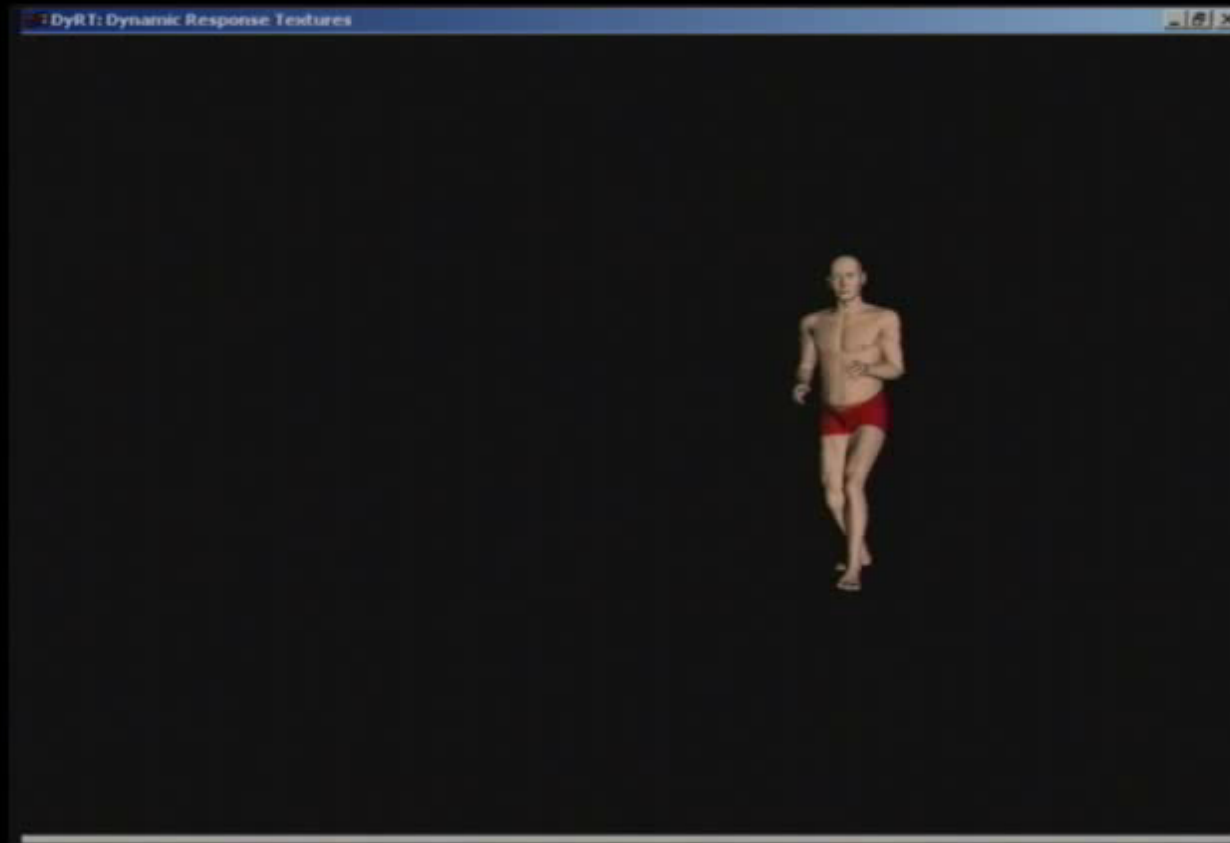


Reality Based Modeling

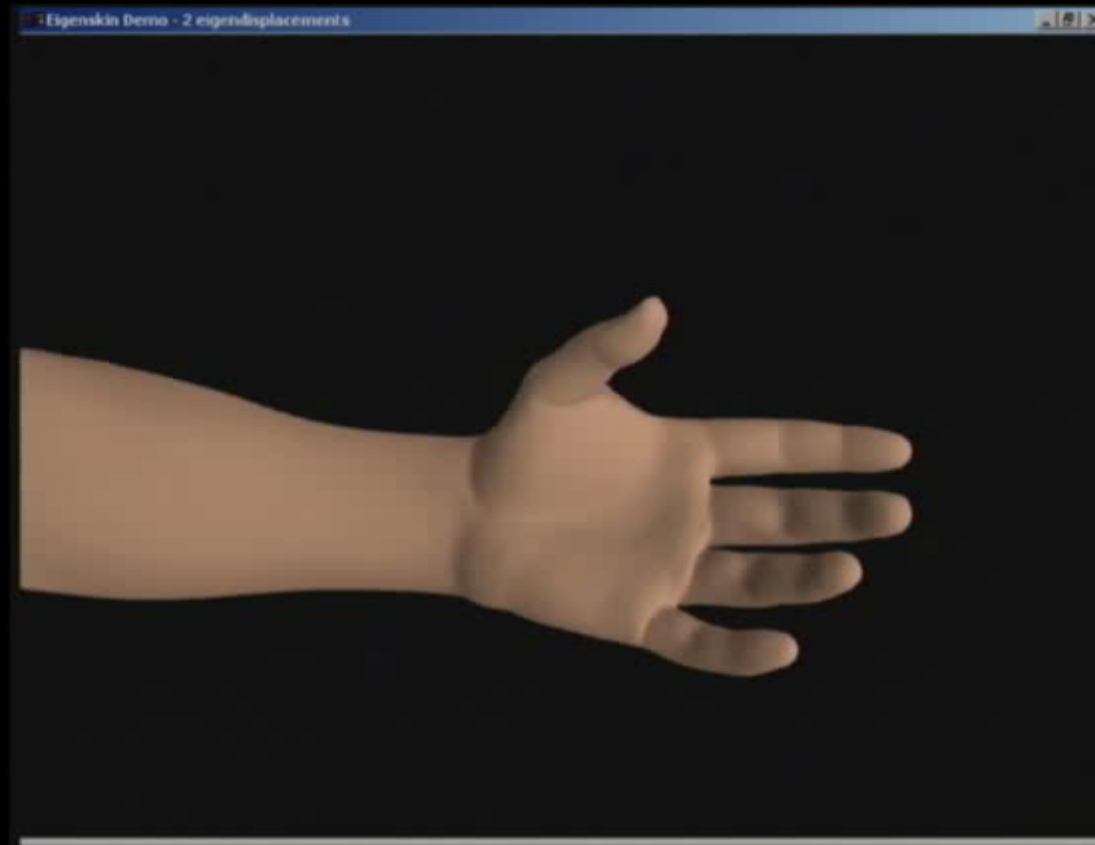
Precomputed Physics



Precomputed Humans



Hardware Acceleration



Precomputed Dynamics + Lighting

Precomputing Interactive Dynamic Deformable Scenes

Doug L. James
Kayvon Fatahalian

Carnegie Mellon University