



SIGGRAPH 1994

*21st International Conference
On Computer Graphics and
Interactive Techniques*

*Orange County Convention Center
Orlando, Florida
July 24-29*

Course Notes

32

AN INTRODUCTION TO
PHYSICALLY-BASED
MODELING

Organizer

Andrew Witkin
Carnegie Mellon University

Lecturers

David Baraff
Carnegie Mellon University

Michael Kass
Apple Computer, Inc.

An Introduction to Physically Based Modeling

Chair:

Andrew Witkin
Carnegie Mellon University

During the past few years, physically based modeling has emerged as an important new approach to computer animation and computer graphic modeling. Although physically based modeling is inherently a mathematical subject, the math involved needn't be any more difficult nor esoteric than the math that underlies many other areas of computer graphics. To date, however, most discussions of the subject have presupposed a specialized mathematical background that many members of the computer graphics community lack.

This course addresses the need to make the principles and methods of physically based modeling accessible to a broader computer graphics audience—those who are familiar with mainstream computer graphics and understand basic computer graphics math, such as vector/matrix manipulations, but whose first year calculus course is a dim recollection.

Course Schedule

8:45 am	Introduction	
9:00 am	Differential Equation Basics	Witkin
9:30 am	Particle Dynamics	Witkin
10:15 am	Break	
10:30 am	Energy Functions and Stiffness	Kass
11:15 am	Continuum Dynamics	Kass
12:00 pm	Lunch	
1:30 pm	Constrained Dynamics	Witkin
3:00 pm	Break	
3:15 pm	Rigid Body Simulation	Baraff
5:00 pm	End	

Course Speakers

Andrew Witkin is a Professor of Computer Science and Robotics at Carnegie Mellon University. He received his B.A. from Columbia College, and his Ph D. from M.I.T. Prior to joining the faculty at Carnegie Mellon, he headed the perception and graphics group at Schlumberger Palo Alto Research. His research interests include computer animation, computer vision, and simulation. He has taught three previous Siggraph courses on physically based modeling.

Michael Kass is a Staff Research Scientist with the Advanced Technology Group of Apple Computer. He received a B.A. in Artificial Intelligence from Princeton University, an M.S. in Computer Science from M.I.T., and a Ph D. in Electrical Engineering from Stanford University. Before joining Apple Computer in 1988, he worked at Schlumberger Palo Alto Research in the field of computer graphics and computer vision. His research focus is on the use of physical simulation for computer graphics.

David Baraff is an Assistant Professor in Carnegie Mellon University's Robotics Institute, and School of Computer Science. He received his Ph D. from Cornell University in 1992, where he was a graduate student in Cornell's Program of Computer Graphics and Department of Computer Science. He received his Bs.E. from the University of Pennsylvania in 1987. At Cornell, he was named an AT&T Bell Laboratories Ph D. Fellow. His research work focuses on physical simulations with constraints. He has taught lecture courses on dynamic simulation at previous Siggraph conferences.

Contents

I — Course Notes

A.	Preliminaries	
B.	Differential Equation Basics	Witkin
C.	Particle System Dynamics	Witkin
D.	Energy Functions and Stiffness	Kass
E.	Intro. To Continuum Dynamics	Kass
F.	Constrained Dynamics	Witkin
G.	Rigid Body Simulation	Baraff
BIB.	General Bibliography	

II — Slides

SB.	Differential Equation Basics	Witkin
SC.	Particle System Dynamics	Witkin
SD.	Energy Functions and Stiffness	Kass
SE.	Intro. To Continuum Dynamics	Kass
SF.	Constrained Dynamics	Witkin
SG.	Rigid Body Simulation	Baraff