

**SIGGRAPH 1990**

**17th International Conference  
On Computer Graphics and  
Interactive Techniques**

**Dallas Convention Center  
August 6th—10th**

## COURSE NOTES

# 23

**MODELING AND  
ANIMATING WITH IMPLICIT  
SURFACES**

***Co-Chairs***

**Brian Wyvill  
University of Calgary  
Jules Bloomenthal  
Xerox PARC**

***Lecturers***

**Thad Beier  
Pacific Data Images  
Jim Blinn  
California Institute of Technology  
Jules Bloomenthal  
Xerox PARC  
Alyn Rockwood  
Silicon Graphics Computer Systems  
Brian Wyvill  
University of Calgary  
Geoff Wyvill  
University of Otago**

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## Modeling and Animating with Implicit Surfaces

### Introduction

Welcome to *Modeling and Animating with Implicit Surfaces*.

In this course we will survey implicit surfaces, discuss their usefulness, describe their advantages and disadvantages relative to other modeling techniques, and present techniques for building, animating, and visualizing these surfaces.

Because they possess nice properties (blending, for example), implicit surfaces are an important area in computer graphics, but an often neglected one: from the moment one realizes it's easier to draw a circle with  $(r \cos \Theta, r \sin \Theta)$  than it is with  $(x^2 + y^2 = r^2)$ , one is slowly led away from the world of implicit surfaces, perhaps never to return!

Welcome back.

Implicit surfaces are different from parametric surfaces; the latter, in use in many commercial modeling systems, is more familiar to most of the computer graphics community. Implicit surfaces aren't necessarily less practical; they're simply different, and may well find different applications from their parametric counterparts. The lecturers in this course will discuss their current work in developing techniques to make implicit surfaces practical in modeling and animation.

By definition, implicit surfaces embrace an extremely large set of surfaces. Undoubtedly, as they receive increased use in such a visible discipline as computer graphics, concepts will be developed that unify and distinguish various implicit forms. We hope the variety of approaches, applications and results presented in this course will stimulate interest in this exciting branch of modeling.

Brian Wyvill  
Jules Bloomenthal  
Palo Alto, CA

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## Modeling and Animating with Implicit Surfaces

### Speaker Affiliations

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Silicon Graphics, presently, but soon:  
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**Modeling and Animating with Implicit Surfaces****Course Schedule**

8:30	Greeting	
9:00	General Introduction to Implicit Surfaces	Blinn
	Polygonizing Implicit Surfaces	B. Wyvill
10:00	Procedural Implicit Surfaces	Bloomenthal
	Mid-Morning Break	
11:00	Implicit Blending	Rockwood
	Implicit Surfaces in CSG Systems	G. Wyvill
12:00	Lunch	
1:00		
2:00	Advanced Algebraic Techniques	Blinn
	Ray-Tracing/Rendering Techniques	Bloomenthal
3:00	Mid-Afternoon Break	
	Texturing Implicit Surfaces	G. Wyvill
4:00	Metamorphosis and other Animation Techniques	B. Wyvill
	Practical Uses of Implicit Surfaces in Animation	Beier
5:00		

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*originally in ACM Transactions on Graphics, July 1982*
- 2-1 ... 2-23      The Algebraic Properties of Homogeneous Second Order Surfaces  
by *James F. Blinn*  
*originally in Mathematics of Computer Graphics course notes, SIGGRAPH 1984*
- 3-1 ... 3-7      Implicit Surfaces in CSG Systems by *Geoff Wyvill*  
*unpublished*
- 4-1 ... 4-15      A Starter Toolkit for Modeling with Implicit Surfaces by *Jim Kleck*  
*excerpted from Modeling Using Implicit Surfaces, thesis, UCSC, June 89*

### Polygonization

- 5-1 ... 5-8      Data Structure for Soft Objects by *G. Wyvill, C. McPheeters, and B. Wyvill*  
*originally in Visual Computer, August 1986*
- 6-1 ... 6-20      Polygonization of Implicit Surfaces by *Jules Bloomenthal*  
*originally in Computer Aided Geometric Design, Nov. 1988*
- 7-1 ... 7-6      Table Driven Polygonization by *Brian Wyvill and Dave Jevans*  
*unpublished*

### Blending

- 8-1 ... 8-17      Notes for Using Implicit Surfaces to Blend Arbitrary Solid Models  
by *Alyn P. Rockwood*  
*unpublished*
- 9-1 ... 9-22      Using Implicit Surfaces to Blend Arbitrary Solid Models by *A. Rockwood*  
*originally in Geometric Modeling: Algorithms and Trends, G. Farin, ed*

- 10-1 ... 10-17 **Blending Surfaces in Solid Modeling by A. Rockwood and J. Owen**  
*originally in Geometric Modeling: Algorithms and Trends, G. Farin, ed*
- 11-1 ... 11-11 **Intersection of General Implicit Surfaces by J. Owen and A. Rockwood**  
*originally in ACM Transactions on Graphics, October 1989*
- 12-1 ... 12-9 **Implicit Blends of Planar Primitives by Jules Bloomenthal**  
*unpublished*

### Rendering

- 13-1 ... 13-18 **Techniques for Implicit Modeling by Jules Bloomenthal**  
*unpublished*
- 14-1 ... 14-7 **Ray Tracing Soft Objects by G. Wyvill and A. Trotman**  
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- 15-1 ... 15-5 **Texturing Implicit Surfaces by Geoff Wyvill**  
*unpublished*
- 16-1 ... 16-7 **Solid Texturing of Soft Objects by G. Wyvill, B. Wyvill, and C. McPheeters**  
*originally in IEEE Computer Graphics and Applications, Dec. 1987*

### Interaction and Animation

- 17-1 ... 17-9 **Interactive Techniques for Implicit Modeling by J. Bloomenthal and B. Wyvill**  
*originally in SIGGRAPH Computer Graphics, Mar. 1990*
- 18-1 ... 18-8 **Animating Soft Objects by B. Wyvill, C. McPheeters, and G. Wyvill**  
*originally in The Visual Computer, August 1986*
- 19-1 ... 19-10 **Metamorphosis of Implicit Surfaces by Brian Wyvill**  
*unpublished*
- 20-1 ... 20-11 **Practical Uses for Implicit Surfaces in Animation by Thad Beier**  
*unpublished*