



**SIGGRAPH 1992**

*19th International Conference  
On Computer Graphics and  
Interactive Techniques*

*McCormick Place, Chicago  
July 26 - 31*

# COURSE NOTES

# 23

**PROCEDURAL MODELING AND  
RENDERING TECHNIQUES**

*Organizer*

**David S. Ebert**  
Ohio State University

*Lecturers*

**F. Kenton Musgrave**  
Yale University

**Darwyn Peachey**  
Pixar

**Ken Perlin**  
New York University

**SIGGRAPH '92 Course 23 :**  
**“Procedural Modeling and Rendering Techniques”**

**Organizer: David S. Ebert**  
**Department of Computer and Information Science**  
**The Ohio State University**

## **Course Abstract**

**This course is intended to give the participant a working knowledge of several procedural approaches in modeling, shading, rendering, and animation. The procedural approaches presented will include two-dimensional textures, solid textures, hypertextures, volume density functions, atmospheric effects, and fractal algorithms. The participant will see the details of these techniques that are normally left out of technical papers, including useful and practical guidelines for selecting parameter values. The course will start with an overview of the different procedural techniques and how they relate. An in-depth description of the basic primitive functions used will be presented, including a thorough presentation of noise and turbulence functions and their implementation. After this introduction, the course will follow a progression in the use of procedural techniques from two-dimensional texturing to solid texturing, to its extension as hypertextures and gas volume density functions. Animations using these techniques will also be presented. Finally, the course will describe atmospheric scattering, fractal applications and their relationship to the other procedural techniques.**

## Speaker Biographies

**David Ebert** is an instructor in the Department of Computer and Information Science at The Ohio State University. He received his PhD in Computer and Information Science in June, 1991. His current research interests include rendering and animating gases and fluids, combining volume and surface-based rendering, texturing, and animation control issues.

Ebert has presented a paper on rendering and animating procedurally defined gases at SIGGRAPH '90, has produced 2 animations featuring this work which won numerous awards and appeared in the SIGGRAPH '89 and SIGGRAPH '90 Animation Screening Rooms. His work has also appeared in the SIGGRAPH '89, '90, and '91 Technical Slide sets as well as several textbooks and the cover of IEEE Computer Graphics and Applications magazine.

**Ken Musgrave** is a lecturer and PhD candidate in the Yale University Department of Computer Science. His research is primarily in the area of modeling natural phenomena, specifically realistic imaging of fractal landscapes; however, he considers the production of fine art with the computer to be his primary goal. He has been a research assistant to Benoit Mandelbrot in the Mathematics Department of Yale University since 1987.

Musgrave's research papers have appeared in IEEE Computer Graphics and Applications, the proceedings of SIGGRAPH '89, Graphics Interface '89, "Graphics Gems II and III", the IBM Journal of Research & Development, and other technical publications. His images have been displayed in the SIGGRAPH '88 and '91 Art Shows and have appeared on the covers of "The Science of Fractal Images", IEEE Computer Graphics and Applications, Computer Graphics World, and SunWorld, as well as in National Geographic, "Fundamentals of Interactive Computer Graphics", the Communications of the ACM and numerous magazines and books internationally.

**Darwyn Peachey** is an Animation Scientist at Pixar. Since 1988 he has worked on the design and implementation of the RenderMan renderers and in-house animation software. Darwyn received M.Sc. and B.Sc. degrees in computer science from the University of Saskatchewan, Canada. Prior to joining Pixar he spent three years developing UNIX kernel software and four years as a member of the computer science research staff at the University of Saskatchewan.

**Ken Perlin** is an Assistant Professor of Computer Science at Courant Institute of Mathematical Sciences of New York University since 1987. He received his Ph.D. in Computer Science at the Courant Institute and his B.A. in Theoretical Mathematics at Harvard University.

Dr. Perlin was Head of Software Development at R/GREENBERG Associates in New York, NY from 1984 through 1987. Prior to that he was the System Architect for computer generated animation at Mathematical Applications Group, Inc., Elmsford, NY. from 1979 to 1984. He is a recipient of the 1991 Presidential Young Investigator Award, and he serves on the Board of Directors of the New York chapter of ACM/SIGGRAPH. He has developed software for a number of films and commercials using computer graphics but his favourite is still TRON, no matter what anybody says.

## Speaker Contact Information

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## Course Schedule

1. **Course Introduction Time: .25 hr** ..... 1-1  
David Ebert
2. **Procedural Textures Time: 1.25 hr** ..... 2-1  
Darwyn Peachey
  - (a) Introduction to Procedural Methods
  - (b) Procedural Texture Generation
  - (c) Antialiasing Procedural Textures
3. **A Hypertexture Tutorial Time: 1.25 hr** ..... 3-1  
Ken Perlin
  - (a) Rendering Support
  - (b) Interaction
  - (c) Example Hypertextures and Their Development
4. **Modeling and Animating Gases and Fluids Time: 1.25hr** ..... 4-1  
David Ebert
  - (a) Introduction to Procedural Modeling and Animation
  - (b) Modeling Gas Geometry
  - (c) Animation Techniques for Procedural Modeling
5. **Procedural Models of Natural Phenomena Time: 1.25hr** ..... 5-1  
Ken Musgrave
  - (a) Introduction
  - (b) Atmospheric Scattering
  - (c) Procedural Fractal Models
  - (d) Example: Terran-Planet Texture
6. **Conclusion Time: .75hr**  
All Speakers

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