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COURSE NOTES *C8*

STATE-OF-THE-ART IN VOLUME VISUALIZATION

Chair
Pat Hanrahan
Princeton University

Lecturers
James Kajiya
California Institute of Technology
Wolfgang Kreuger
ART + COM
Peter Schroeder
Thinking Machines Corporation
Jane Wilhelms
University of California at Santa Cruz

Course description

Volume visualization is rapidly turning into one of the most important research topics in computer graphics. This course will provide the attendee an opportunity to hear about the latest developments in this area. Emphasis will be on new algorithms and new approaches to volume visualization that have not yet seen wide application, but have the potential to revolutionize our ability to visualize volume data in a wide variety of applications. This course will also develop the theory of various topics relevant to volume visualization at a more advanced level. Topics to be covered include volume rendering of curvilinear and irregular grids (typical of finite element and computational fluid dynamics applications), the theory of multidimensional resampling, the texel model and the theory of anisotropic scattering, volume transport theory (and visualization techniques inspired by transport), and, finally, approaches to volume rendering on massively parallel machines such as the Connection Machine. The course will also include a panel discussion focusing on future research directions in volume rendering.

Speaker Addresses

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Biographies

Pat Hanrahan

Pat Hanrahan is an assistant professor of computer science at Princeton University where he teaches computer graphics. His current research involves volume rendering, image synthesis, and graphics systems and architectures. Before joining Princeton, he worked at Pixar where he developed developed volume rendering software and was the chief architect of the RenderMan(TM) Interface – a protocol that allows modeling programs to describe scenes to high quality rendering programs. Previous to Pixar he directed the 3D computer graphics group in the Computer Graphics Laboratory at New York Institute of Technology.

Jane Wilhelms

Jane Wilhelms, assistant professor of computer and information sciences, received her B.A. in zoology for the University of Wisconsin-Madison, an M.A. in biology from Stanford University, and an M.S. and Ph.D. in computer science from the University of California, Berkeley. Her research interests in computer graphics center around scientific visualization, physical simulation, and animation.

James T. Kajiya

James T. Kajiya received his Ph.D. Degree in Computer Science from the University of Utah in 1979. His thesis research, by applying Lie group representation theory to the modeling of the Human Visual System as a signal processing system, was able to explain a wide range of phenomena in monochrome brighness perception as well as predict several new visual illusions and phenomena. Since 1979, Dr. Kajiya has been at the California Institute of Technology, first as an assistant professor, then as associate professor of Computer Science. Dr. Kajiya has published on mathematical models for computer vision, very high level programming languages, and mathematical logic for computer science. His recent work has focused on very high quality computer graphics. This work has included nonlinear antialiasing algorithms for the display of text on raster screens, invention of several new techniques for ray tracing primitives such as swept volumes, parametric patches and fractal surfaces, an early paper on volume rendering, a hierarchical bounding box technique for accelerating ray tracing, the introduction of anisotropic light reflection models for surfaces, the introduction of algebraic geometry in patch computations, a new technique extending the ray tracing process via an integral equation/monte carlo algorithm called the "rendering equation", and most recently, a solution to the problem of rendering fuzzy surfaces.

Peter Schroeder

Mr. Schroeder received his undergradudate degree (Vor-Diplom) in Mathematics and Computer Science from the Technical University of Berlin before working on his SM degree from MIT at the Media Laboratory. There he worked in the Computer Graphics and Animation group and focused primarily on physical modeling in interactive virtual environments. Since completing his studies at the beginning of 1990 he has been working in Thinking Machines' Visualization Group. His research focusses on efficient graphics algorithms for massively parallel SIMD computers in general and volume rendering in particular.

Schedule of Talks

0:30 Introduction (Hanrahan)

1:00 Curvilinear and Irregular Grids (Wilhelms)

0:45 Multidimensional Resampling (Hanrahan)

0:45 Texels (Kajiya)

0:45 Transport Theory (Krueger)

1:00 Data Parallel Volume Algorithms (Schroeder)

0:30 Panel discussion

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Decisions in Volume Rendering

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