Line Drawings from 3D Models

SIGGRAPH 2005 Course 7

Half-Day, Sunday, 31 July, 1:45 - 5:30 pm
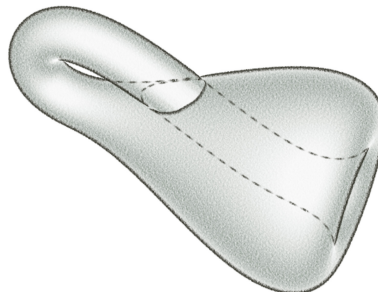
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Lecturers

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Course Description

Nonphotorealistic rendering techniques, including line drawings, can be remarkably efficient at conveying shape and meaning while reducing visual clutter. This course will describe techniques for automated rendering of 3D models using a number of sparse line drawing styles, for both artistic and illustrative purposes. We will mathematically define lines such as silhouettes, contours, suggestive contours, and ridges and valleys. We describe algorithms for finding them efficiently, discuss methods of stylization, and provide a brief introduction to abstraction and visual perception. Applications of these techniques include stylized rendering for technical illustration, cartoons, art, and the study of how shape is perceived.

Prerequisites

Basic familiarity with the computer graphics pipeline and some knowledge of calculus and linear algebra.

Intended Audience

Practitioners and researchers who would like a deeper understanding of how NPR line drawings are created and why they are effective.

Presenters

Doug DeCarlo received BS degrees in computer science and computer engineering from Carnegie Mellon in 1991, and his PhD in computer science from the University of Pennsylvania in 1998. He is currently an assistant professor in the Department of Computer Science with a joint appointment in the Center for Cognitive Science at Rutgers University. His research in computer graphics explores how accounts of human perception and communication can inform the design of computer systems that engage in effective visual communication.

Adam Finkelstein is an associate professor in the Computer Science Department at Princeton University. His current research focuses on non-photorealistic rendering and animation. Adam received a doctorate from the University of Washington in 1996. From 1987 to 1990, he worked at Tibco developing software for people who trade stock. He received a BA in 1987 from Swarthmore College.

Szymon Rusinkiewicz has been an assistant professor at Princeton University since 2001, after obtaining a PhD from Stanford University. His main research interests are in computer graphics, focusing on techniques that make use of shape, light, and reflectance acquired from the real world. He also works on real-time rendering of large models, shape analysis, and rendering algorithms guided by human visual perception.

Acknowledgements

Course Syllabus

I. Nonphotorealistic rendering (Finkelstein)

- Why NPR?
- Techniques

II. Defining lines on surfaces (Rusinkiewicz)

- Silhouettes and contours
- Basics of differential geometry for surfaces in 3D
- Suggestive contours
- Ridges and valleys

III. Line drawings and perception (DeCarlo)

- Line drawings by artists
- Information in line drawings
- Ambiguities
- Psychophysical studies

—Break—

IV. Algorithms for finding lines (Rusinkiewicz)

- Image-space algorithms
- Object-space algorithms and acceleration techniques
- Hybrid algorithms

V. Stylization of line drawings (Finkelstein)

- Visibility
- Parameterization
- Temporal coherence
- User interaction

VI. Abstraction and evaluation (DeCarlo)

- Abstraction, attention and detail
- Evaluation of NPR displays