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Applications of Visual Perception in Computer Graphics

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course notes

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Victoria Interrante, Penny Rheingans, James Ferwerda,
Rich Gossweiler and Christopher Healey

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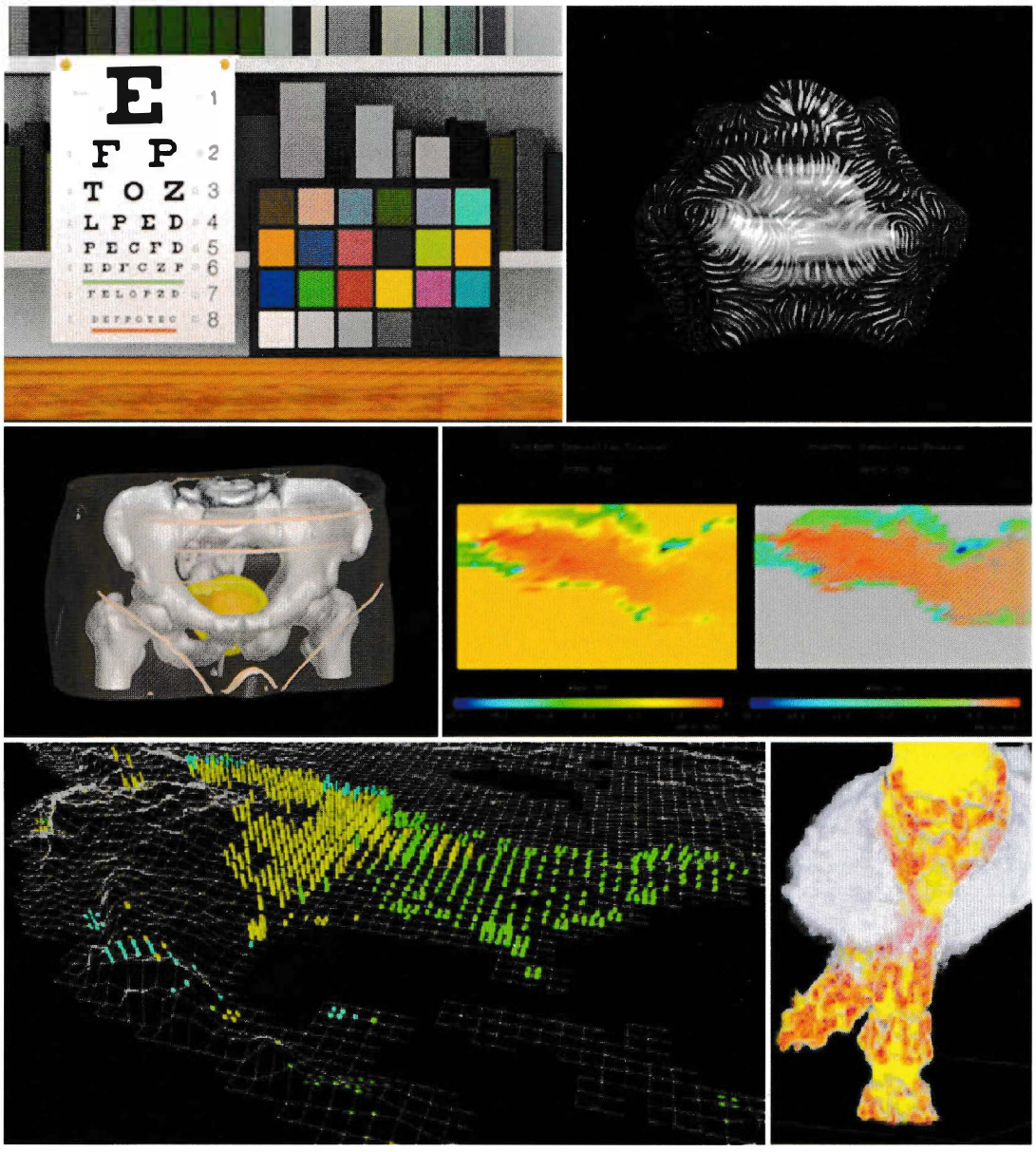


Course Summary

This course provides an introduction to the study of visual perception and its applications in computer graphics. The course surveys fundamental findings in human visual perception and cognition, and focuses on the use of these results in specific applications and ,information visualization, and time·critical rendering for virtual environments.

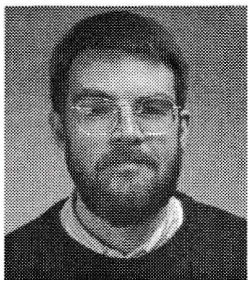
The course is structured as a set of independent but complementary 'pillars' of information. Within each topic area, we build from a broad survey of basic perceptual concepts up to techniques for applying this perceptual information to the solution of particular problems in diverse areas of computer graphics.

This course is intended to be of interest to a wide range of graphics researchers and practitioners who want to understand how to create images that can be effectively interpreted by the human visual system. Participants are assumed to have some basic experience in graphics and/or visualization, but no prior knowledge or background in perceptual psychology is expected or required.

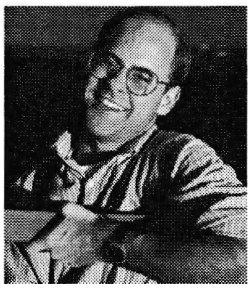
Course Organizers

Victoria Interrante is a staff scientist at ICASE, a center of research in applied mathematics, numerical analysis and computer science operated by the Universities Space Research Association at the NASA Langley Research Center. She received a PhD in Computer Science from the University of North Carolina at Chapel Hill in 1996, where she completed a dissertation under the direction of Drs. Henry Fuchs and Stephen Pizer on the design of perceptually-inspired artistic techniques for improving the comprehensibility of layered transparent surfaces. Her current research focuses on the application of insights from perceptual psychophysics, art and illustration to the design of more effective techniques for visualizing data, the study of shape and depth perception, the development of automatic methods for intuitively conveying essential aspects of intrinsic shape via texture, shape-based feature extraction, and the representation of 3D flow using volume line integral convolution.

Penny Rheingans is an assistant Professor of Computer Science at the University of Mississippi. She received a Ph.D. in Computer Science from the University of North Carolina, Chapel Hill and a BA in Computer Science from Harvard University. Before coming to the University of Mississippi, Dr. Rheingans was a Visualization Specialist for Martin Marietta at the US EPA Scientific Visualization Center, where she developed tools and techniques for the more effective display of environmental data. While at UNC, she developed tools for the visualization of molecular surfaces, the design and manipulation of color mappings for bivariate information, and the utilization of virtual reality technology to conduct interactive walkthroughs of very large architectural databases. Her current research interests include multivariate visualization, perceptual issues in visualization, dynamic representations, the application of texture to data visualization, and the experimental validation of visualization techniques.



James A. Ferwerda is a senior member of the research staff at the Program of Computer Graphics at Cornell University. His academic background is in human experimental psychology and computer graphics. He currently leads a research group on perceptual issues in image synthesis at the Program of Computer Graphics. His research interests include image quality, color appearance, visual models for realistic image synthesis, 3d user interface design, and computer supported communication systems. He is a member of ACM SIGGRAPH, the IEEE, and the Society for Imaging Science and Technology.



Rich Gossweiler is research scientist in the User Interface Research Group at Xerox PARC, where he is currently working on Information Visualization. He received his Ph.D. in Computer Science from the University of Virginia in 1996. At UVa, he developed DIVER, the rendering engine for the Department's Virtual Reality system and later for the Alice system. Working with faculty from both the Psychology department and the Computer Science department, his Ph.D. work focused on Time-Critical Rendering (TCR) using perception-based techniques. Towards the end of his research at UVa, Rich became interested in developing perception-based, three-dimensional interfaces in more traditional desktop computing environments. Rich was then employed by Silicon Graphics, Inc., where he contributed to the VRML 2.0 specifications and helped develop Cosmo Worlds, a commercial VRML authoring system. At PARC, he has been developing a rapid-prototyping system that allows researchers to visualize and navigate large datasets, such as the web.

Christopher Healey is a postdoctoral researcher working in computer graphics with Dr. Carlo Sequin at the University of California, Berkeley. He recieved a B. Math at the University of Waterloo, Canada in 1990, and a M.Sc. and Ph.D in Computer Science at the University of British Columbia., Canada in 1996. During his Ph.D. he was supervised by Dr. Kellog S. Booth (Department of Computer Science) and Dr. James T. Enns (Department of Psychology). His dissertation studied methods for displaying effectively large, multidimensional datasets during scientific visualization. This work investigated methods for exploiting the low-level human visual system during visualization. His current research focuses on the use of visual features like color, orientation, and texture for analyzing multidimensional data. He is also investigating statistical, mathematical, and database techniques for preprocessing large datasets to reduce their size and dimensionality before visualization.

Course Schedule

First morning session 8:30 - 10:00

1- Introduction (Gossweiler, 5 min)

2- Fundamentals of Spatial Vision (Ferwerda, 85 min)

Coffee Break

Second morning session 10:15 - 12:00

3- Color Perception and Applications (Rheingans, 45 min)

4- Motion and Interaction (Rheingans, 30 min)

5- Cognitive Issues in Visual Perception (Interrante, 30 min)

Lunch Break

First afternoon session 1:30 - 3:00

- 6- Low-Level Human Vision and its Impact on Information Display (Healey, 70 min)
- 7- Perceiving 3D Shape and Depth (Interrante, 20 min)

Coffee Break

Second afternoon session 3:15 - 5:00

8- Representing 3D Shape and Depth (Interrante, 30 min)

9- Perception and Realtime 3D Graphics Applications (Gossweiler, 75 min)

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