Practical 3D User Interface Design

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Course 23 NOTES

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Practical 3D User Interface Design: Siggraph 1995

Course Notes for Siggraph 1995

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Course Speakers
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Kevin Smith — Wavefront Technologies
Paul Isaacs — Silicon Graphics Computer Systems
Kevin Mathews — Artifice, Inc.
Roman Ormandy — Caligari Corp.
Mark Mine — University of North Carolina at Chapel Hill

Abstract

This full-day course covers principles and techniques for creating 3D user interfaces (3D UIs) for modeling, animation, information visualization, multimedia, and other emerging interactive systems with an emphasis on production quality applications. Speakers will address their design principles and design processes, the choices they made, and the results of their final implementations. We will focus on real-world 3D UI problems and practical solutions.

3D UI design is becoming increasingly important as traditional 2D interface techniques become less and less adequate to tasks presented in complex 3D interactive applications. But 3D UI design is in its infancy and, unlike 2D UI design, has no collection of design guidelines, examples, publications, courses, and programs of study. This course, the first of its kind, will elucidate many of the issues in 3D UI design and present tangible techniques for creating one's own 3D UIs.

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Daniel C. Robbins — Brown Computer Graphics Group 3.0
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Kevin Smith — Wavefront Technologies 7.0
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Mark Mine — University of North Carolina at Chapel Hill 8.0
- Presentation Slides
- Tech Report: ISAAC: A Virtual Environment Tool for the Interactive Construction of Virtual Worlds, UNC Chapel Hill Computer Science Technical Report TR95-020.
- Tech Report: A Review and Analysis of Through-the-Window Computer-Aided Modeling Systems, UNC Chapel Hill Computer Science Technical Report TR94-070.ISAAC, UNC Techreport TR95-020, May 5, 1995.

Speaker Contact Information **9.0**
Daniel C. Robbins (Course Organizer)
Paul Isaacs
Kevin Mathews
Roman Ormandy
Kevin Smith
Mark Mine

Included Publications **10.0**

Acknowledgments **11.0**

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1.0 Abstract

This full-day course covers principles and techniques for creating 3D user interfaces (3D UIs) for modeling, animation, information visualization, multimedia, and other emerging interactive systems with an emphasis on production quality applications. Speakers will address their design principles and design processes, the choices they made, and the results of their final implementations. We will focus on real-world 3D UI problems and practical solutions.

1.1 Motivation

3D UI design is becoming increasingly important as traditional 2D interface techniques become less and less adequate to tasks presented in complex 3D interactive applications. But 3D UI design is in its infancy and, unlike 2D UI design, has no collection of design guidelines, examples, publications, courses, and programs of study. This course, the first of its kind, will elucidate many of the issues in 3D UI design and present tangible techniques for creating one's own 3D UIs. Using a 3D interface can enhance the effectiveness of 3D interactive applications by

- eliminating switching between 2D and 3D metaphors
- reducing the cognitive distance between the user and the application
- enhancing the display of information, allowing more information to be displayed to the user in a more understandable format
- supporting inherently 3D tasks

1.2 Course Goals

The goal of this course is to present effective design processes and principles for three-dimensional user interface (3D UI) design. Attendees will learn techniques for designing user interfaces that directly link user actions with application objects for tasks such as picking, viewing control, object manipulation, scene construction, animation specification, and data linking. This course will help attendees identify and evaluate interaction tasks used in interactive applications. The material presented will give attendees a rich repertoire of new 3D interaction techniques for their applications.

1.3 Course Highlights

- discussion of the design process
- principles of UI design
- applying design principles
- integrating 3D UIs into applications
- effective use of 3D UIs in complex applications
- the future of 3D UIs

This course emphasizes the application of 3D UI design principles and the development of successful design processes. We will focus on real-world 3D UI problems and practical solutions. The presenters for this course are developing the cutting edge of practical 3D UI design for both desktop systems and emerging technologies. They will discuss design decisions made in implementing their own application and how these decisions contribute to the larger issue of 3D UI design. Attendees will be presented with definitions, examples, methods, and guidelines for designing their own robust 3D UIs that make use of affordances, cues, and status indications. This discussion will be informed by implementation issues such as hardware platforms and 3D APIs, and will explore why some 3D UI designs are successful while others are not.

2.0 Schedule/Syllabus

2.1 Motivation: Why 3D UIs?

Dan Robbins, *Interactive Illustration Designer, Brown Computer Graphics Group*

- limitations of 2D UIs
- benefits of 3D UIs (reducing cognitive distance, easy migration to VR, more natural than 2D UIs for inherently 3D tasks, shallow learning curve)
- example cutting-edge 3D UIs

2.2 Process: Understanding Users via the 3D UI Design Process

Dan Robbins

- generalizing high-level tasks from watching user's actions
- empowering users vs. power users
- identifying tasks that are difficult to accomplish in current implementations
- generating ideas by borrowing from the real world, graphic design, 2D UI design, industrial design, etc.
- rapid prototyping
- testing techniques informally

2.3 Principles: Designing Toolkits to Support 3D UIs

Paul Isaacs, *3D UI Designer/Toolmaker, Silicon Graphics Computer Systems*

- universal design considerations: occlusion, clutter, channels, affordances, cues, animation, rendering, consistency
- determining the set of base primitives to satisfy the 80/20 rule
- determining what primitives are common to and can be used in a wide variety of applications
- upgrading prototype tools to unbreakable UI components

2.4 Implementation: Keeping Simple Tasks Simple via 3D UIs

Kevin Mathews, *President, Artifice, Inc.*

- supporting the 3D design and modeling process with "natural and transparent interaction"
- picking appropriate freedoms and appropriate constraints (what is a "good tool?")
- establishing spatial relationships between objects and between tool and object (non-stereographic depth cueing, etc.)

- correlating 2 1/2D and 3D operational modes by seamlessly using feature-based modeling concepts
- correlating object-manipulation methods with view-manipulation methods (and their potential interdependence)
- working without hardware acceleration of 3D graphics (tricks of minimalism)

2.5 Integration: Integrating Diverse Tasks via 3D UIs

Roman Ormandy, *President, Caligari Inc.*

- presenting a consistent 3D UI for modeling, texturing, and animation
- accommodating users of different levels
- integrating modeling, texturing, and animation into one modeless application
- blurring the difference between application objects and 3D UI elements
- extending 3D interfaces beyond modeling and animation

2.6 Management: Handling Complex Tasks via 3D UIs

Kevin Smith, *3D Software Engineer, Wavefront Technologies*

- keeping the 3D UI simple while still supporting a large function set
- achieving the proper balance between 3D and 2D UIs in large systems
- working with users to refine 3D UIs
- effective and practical use of alternate input devices

2.7 The Future?: Virtual Environments Empowered via 3D UIs

Mark Mine, *Graduate Student in Immersive Modeling, University of North Carolina at Chapel Hill*

- determining the advantages and disadvantages of working in a virtual environment — what makes VR practical
- characterizing the differences between "through-the-window" and VR
- designing interaction techniques and UIs for a virtual environment
- dealing with the limitations of current virtual environment technology
- demonstrating and critiquing several VR interfaces

2.8 Unsolved Problems

all speakers

Speakers were given in advance a sample unsolved 3D UI problem. Each speaker responded, during the course, with several possible solutions to this problem. Possible "unsolved problems" are:

- hierarchy: what kind of 3D UI can be used to create, edit, and display groups, parents, children, siblings, and other data relationships?
- 3D UIs for non-geometric qualities: what is the best way to control qualities such as color, transparency, weight, and time?
- precision: how can a user be precise when using gestural controls?
- 3D navigation: why are there still no good methods for viewing control?

2.9 Conclusions

- using 3D interfaces for non-traditional tasks
- promoting the acceptance of 3D interfaces