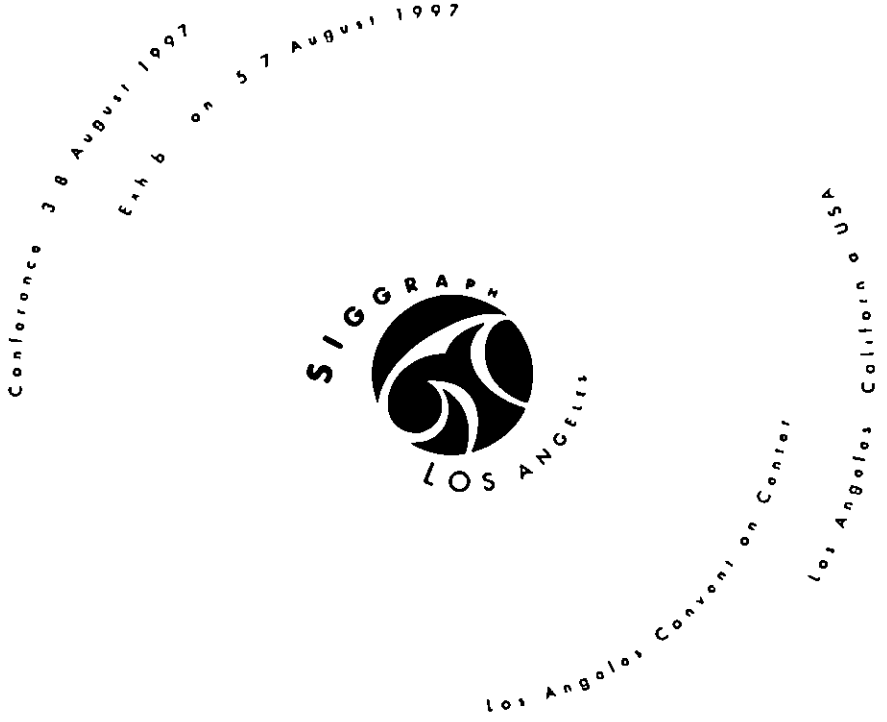
SIGGRAPH 97
24TH INTERNATIONAL CONFERENCE
ON COMPUTER GRAPHICS
AND INTERACTIVE TECHNIQUES

Programming Virtual Worlds



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COURSE NOTES

29

Programming Virtual Worlds

ORGANIZER

Anselmo Lastra
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LECTURERS

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Division Limited

Henry Fuchs
Anselmo Lastra
Russell Taylor
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Course Notes
Programming Virtual Worlds

SIGGRAPH 97

Organizers
Anselmo Lastra
Henry Fuchs
University of North Carolina, Chapel Hill

Lecturers
Stephen Ghee, Division, Ltd
Randy Pausch, Carnegie Mellon University
Russell M Taylor II, University of North Carolina
Hans Weber, University of North Carolina

Abstract
This course provides an introduction to virtual reality, primarily using immersive displays It covers hardware system requirements, design of applications, an introduction to haptics, and the implementation of virtual worlds The emphasis of the course is on the practical issues that must be addressed to begin working in virtual environments

Programming Virtual Worlds
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Schedule

Virtual Reality Past, Present, and Future *Henry Fuchs*	45 minutes
Technology for Virtual Reality *Anselmo Lastra*	1 hour
Break	
Interaction in a Virtual Environment *Hans Weber*	1 hour 15 minutes
Lunch	
Alice A Rapid Prototyping System for Virtual Reality *Randy Pausch*	1 hour
Programming Virtual Worlds *Steven Ghee*	1 hour
Break	
Programming Force Feedback Devices in Computer Graphics Systems *Russell Taylor*	1 hour

Course Description

Anselmo Lastra

For years there has been a great deal of interest in the field of virtual reality However, initially there was not much user-level activity in the field, mostly because it was very hard for people to experiment with VR The expense and the difficulty of setting up a system kept all but a hardy and persistent few from setting up laboratories Within the last few years, however, a variety of hardware and software have become available These new products enable interested parties with moderate budgets to set up VR systems for use in areas such as visualization, and human computer interaction This course is intended to get those people started working with virtual worlds

The morning begins with an overview of a typical VR system, followed by a description of the basic hardware components and how to choose them This section is important because selecting hardware for VR systems is not straightforward The course notes will show in detail what hardware is available, but the class time will mostly be spent on describing what the important hardware specifications mean

The second half of the morning is devoted to the design of virtual worlds Using applications as case studies, we will illustrate modes of interaction in the virtual environment The intent is to show the students what sorts of things are possible, and to guide them in solving their application problems using virtual worlds techniques This section of the course will be illustrated with video tape of a variety of applications for modeling and visualization (architectural, medical, scientific) from the University of North Carolina

The afternoon session shows the students how to implement their virtual worlds using two very interesting development systems Rather than survey the field of VR software, we decided to describe and contrast two systems, one a leading commercial development system, the other freely available The intent is to provide enough information for the students to get started, but not bias their choice of software unduly

The first system, Alice, is an interpreted, object-oriented rapid-prototyping environment A goal for Alice is to allow programmers to build virtual worlds based on a 10 page, two-hour long tutorial The second system, dVS, is a platform-independent software environment for the development of virtual reality applications, based on a distributed, multi-server architecture dVS supports multiple-host and multiple-user virtual environments Higher level functions are provided in the form of an object based toolkit called VCTools

The final section of the course provides an introduction to programming force feedback into virtual worlds We'll first introduce the field and the basic concepts We'll then have a closer look at applications using low-cost force feedback devices

Speaker Biographies

Henry Fuchs

Henry Fuchs is Federico Gil Professor of Computer Science and Adjunct Professor of Radiation Oncology at the University of North Carolina at Chapel Hill He received a Ph D in Computer Science from the University of Utah in 1975 He has been involved in three-dimensional biomedical imaging and graphics since 1969 and in work related to head mounted displays since 1970 At present, he is predominantly involved in the field of virtual reality in medicine through his work on the Medical Imaging Program Project and his research in head-mounted displays Prof Fuchs is one of the inventors of the Pixel-Planes high-performance graphics engine, currently the world's fastest graphics computer, and is a principal investigator for the work on its successor, PixelFlow He has over ninety publications resulting from his research in computer graphics, particularly interactive, three-dimensional computer graphics He received the 1992 Computer Graphics Achievement Award from ACM/SIGGRAPH, the 1992 National Computer Graphics Association Academic Award, and, most recently, the 1997 Satava Award for "unique vision and commitment to the transformation of medicine through communication " He was elected to the National Academy of Engineering in 1997 He has been a member of the National Research Council Computer Science and Telecommunications Board since 1993 He was an associate editor of ACM Transactions on Graphics (1983 1988) and the guest editor of its first issue (Jan 1982) He was the technical program chair for ACM Siggraph 81 Conference, chairman of the 1985 Chapel Hill Conference on Advanced Research in VLSI, chairman of the 1986 Chapel Hill Workshop on Interactive 3D Graphics, co-director of the NATO Advanced Research Workshop on 3D Imaging in Medicine (1990), and co-chair of the National Science Foundation Workshop on Research Directions in Virtual Environments (1992) He has served on industrial advisory boards for many years

Steven Ghee

Steve Ghee, BSc (1st class honours) in MicroElectronics and Microprocessor Applications from the University of Newcastle Upon Tyne One of the founders of Division, Steve now holds the post of Director of Engineering Steve (alone!) wrote the original dVS system, and is now tasked with defining new features in all Division's VR products (both hardware and software)

Anselmo Lastra

Anselmo Lastra is a Research Associate Professor of Computer Science at the University of North Carolina at Chapel Hill He serves as the software manager for the Pixel-Planes/PixelFlow research team The research group is currently working on designs for image based rendering and completing PixelFlow, a scalable graphics computer expected to perform more than an order of magnitude faster than their previous machine, Pixel-Planes 5 Dr Lastra received Ph D and M S degrees in Computer Science from Duke University and a B S E E from the Georgia Institute of Technology Prior to coming to North Carolina, he was a project manager at Coulter Electronics, leading the development of medical instrumentation, and was a consultant at AT & T Bell Laboratories

Randy Pausch

Randy Pausch is an Associate Professor of HCI, Computer Science, and Design at Carnegie Mellon University He is a National Science Foundation Presidential Young Investigator and a Lilly Foundation Teaching Fellow His primary interests are human-computer interaction and undergraduate education In 1995, he spent a sabbatical with the Walt Disney Imagineering Virtual Reality Studio

Russell M Taylor II

Russell Taylor is a Research Assistant Professor in the Computer Science department at the University of North Carolina at Chapel Hill He is currently leading the Nanomanipulator project, an effort which provides a virtual reality interface to Scanning Probe Microscopes including a force-feedback hand controller as part of the interface Russell has also worked on the force-feedback molecular docking program and on VR projects using force feedback

Hans Weber

Hans Weber is a doctoral candidate at the University of North Carolina at Chapel Hill and is currently working on his thesis, "Predictive Head Tracking Using a Body-centric Coordinate System" He received an A B degree in Computer Science from Harvard University in 1991 and has been working on the Architectural Walkthrough and Tracking Projects at UNC since that time His interests include tracking and filtering, virtual environment systems, human-computer interaction, and global illumination algorithms