

Building Interactive Worlds in 3D

Pre-Visualization for Games, Film, and the Web
Jean-Marc Gauthier

AMSTERDAM • BOSTON • HEIDELBERG • LONDON
NEW YORK • OXFORD • PARIS • SAN DIEGO
SAN FRANCISCO • SINGAPORE • SYDNEY • TOKYO
Focal Press is an imprint of Elsevier

Library of Congress Cataloging-in-Publication Data
British Library Cataloguing-in-Publication Data
A catalogue record for this book is available from the British Library.
ISBN: 0-240-80622-0
For information on all Focal Press publications
visit our website at www.focalpress.com
05 06 07 08 09 10 10 9 8 7 6 5 4 3 2 1

Table of Contents

Acknowledgments	
Contributors.....	
Preface.....	
Introduction	
Chapter 1	
Emergence of Virtual Spaces	
1 Emergence	
2 Discussion about Virtual Spaces	
2.1 Let's Start the Discussion	
2.2 Notes on the Discussion	
Chapter 2	
The Basic 3D Kit	
1 The Roadmap	
2 The Making of Cyclop, an Interactive Character in Maya	
2.1 Tour of Maya's Interface	
2.2 Modeling	
2.3 Materials and Textures	
2.4 Building a Skeleton with Inverse Kinematics	
2.5 Creating a Walk Animation	
2.6 How to Export the Character to Virtools	
2.7 What Did You Learn in This Tutorial?	
3 Creating a 3D Immersive Environment	
3.1 Creating the Ground	
3.2 Painting the Trees	
3.3 Painting Grass	
3.4 Conversion of 3D Models to Polygonal Meshes	
3.5 Reducing the Number of Polygons	
3.6 Materials and Textures	
3.7 How to Export the Scene to Virtools	
v	
FM.qxd 12/11/04 12:13 PM Page v	
3.8 Setting Up the Scene in Virtools.....	

3.9 Loading Textures from Maya in Virtools	
3.10 Creating a Skybox	
3.11 Using Textures with Alpha-Channels.....	
3.12 Importing a Character.....	
3.13 The Character Stands on the Floor	
3.14 The Character Walks.....	
3.15 What Did You Learn in This Tutorial?	
Chapter 3	
Interactive Textures and Lighting Design.....	
1 Introduction.....	
1.1 Bitmaps and Procedural Images.....	
1.2 Shaders.....	
1.3 Displacement Maps.....	
1.4 Procedural Painting.....	
1.5 Particle Animation	
2 Texture Primer: Creating a Skybox	
2.1 Origins of the Skybox	
2.2 Skybox Tutorial	
2.3 Design of a Skybox in Lightwave Modeler	
2.4 Create a Scene with Lights and Cameras in Lightwave	
2.5 Creating a Database to Manage 3D Assets in Virtools.....	
3 Create Interactive Textures: Bitmaps and Procedural Images ..	
3.1 Blending Textures Looped in Time	
3.2 Blending Textures Controlled by Viewer's Input	
3.3 Scrolling Textures.....	
3.4 Scrolling Texture with a Transparent Background.....	
3.5 Playing Movie Clips in a Loop Controlled by the Viewer	
3.6 Playing Movie Clips Controlled by the Viewer	
3.7 Using a Live Video from a Virtual Camera.....	
3.8 Texturing with a Random Live Video Signal.....	
3.9 Texturing with Live Video Signals Controlled by the Mouse..	
3.10 Controlling a Texture with an Animated Character	
3.11 Texturing with Two Distinct Live Video Signals	
3.12 Texturing with Two Live Video Signals Reflected in a Mirror	
3.13 Texturing with Live Video Stream from a Video Camera	
4 Programmable Shaders.....	
4.1 The X-Ray Shader, Created by Zach Rosen.....	
4.2 Focus and Defocus.....	
5 Displacement Maps	
6 Vertex Painting	
7 Procedural Painting	
7.1 Painting in 3D with One Texture	
8 Examples of Particle Animation	
8.1 Designing a Planar Particle Emitter	
8.1.1 Creating the Particle Emitter.....	
8.2 Designing Behaviors for Flying Particles	
8.2.1 Particle Emitters	
8.2.2 Particle Deflectors	
8.2.3 3D Objects Can Replace Textures in a Particle Animation Setup.....	
9 Design of a Futuristic City	
9.1 Designing the City	
9.1.1 Creating Textures in Photoshop®.....	
9.1.2 Modeling the Cityscape in Bryce	
9.1.3 Textures, Lights, and Cameras.....	
9.2 Particle Animation and Texture Blending in Virtools.....	

9.2.1 Texture Blending	
9.2.2 Particle Animation of the Traffic of Flying Vehicles	
9.2.3 Particle Animation of the Fires.....	

Chapter 4

Kinematics	
1 Introduction.....	
1.1 Kinematics	
1.2 Key-Frame Animations	
1.3 Why Use Event-Driven Motions?	
1.3.1 Hybrid Animation Systems.....	
1.3.2 Parametric Animations	
1.4 Using Pseudophysics.....	
1.5 Virtual Worlds with Physics	
1.6 Moving Physicalized 3D Objects.....	
1.6.1 Translation with Physics.....	
1.6.2 Rotation with Physics	
1.6.3 Adding New Objects to a Simulation with Physics....	
2 Creating Simple Motions and Manipulations	
2.1 Rolling Stones.....	
2.2 Multiple Collisions	
<i>Table of Contents vii</i>	
FM.qxd 12/11/04 12:13 PM Page vii	
2.3 Driving	
2.3.1 Driving with Pseudophysics.....	
2.3.2 Driving a String of Balls with Physics.....	
2.4 Springs.....	
2.4.1 Setting Up Physics for the Falling Object	
3 Mesh Deformations	
3.1 Twisting and Bending	
3.1.1 Twisting	
3.1.2 Bending.....	
3.2 Applying Noise to a Mesh	
3.3 Interactive Displacement of Vertices of a Mesh with a Mouse	
3.4 Moving One Vertex at a Time by Hand.....	
4 Complex Moving Structures	
4.1 Snake	
4.1.1 Building the Snake.....	
4.1.2 Driving the Snake	
5 Inverse Kinematics.....	
5.1 Bird	
5.2 The Hand	
6 Motion Planning	
6.1 "3D Hand with a Pendulum" Project.....	
6.2 Path Finding	
6.2.1 Setting Up a Character with Path Finding on a Terrain	
6.2.2 Moving Goals through Time.....	
7 Conclusion	

Chapter 5

Interactive Paths	
1 Story of a Famous Path	
1.1 Designing Paths	
1.2 Managing Paths	
2 Paths Tutorials.....	
2.1 How to Set Up the Path of an Insect Flying Along	

the Branch of a Tree.....	
2.2 Controlling the Speed of a Camera on a Path.....	
2.3 Interactive Motion Control of a Camera on a Path	
2.4 Cameras Can Jump from One Path to Another.....	
2.5 Viewers Can Jump from One Camera to the Other.....	
2.6 How to Switch Cameras on the Same Path.....	
2.7 How a Moving Object on a Path Can Detect and Avoid Obstacles	
2.8 How to Record a Path on the Fly.....	
3 The Donut Tutorial: Setting Up a Camera Inside an Interactive Race Track	
3.1 Conceptual Design.....	
3.2 Let's Start the Tutorial.....	
3.2.1 Conceptual Design	
3.2.2 Modeling a Donut-Shaped Ring	
3.2.3 Texturing the Donut	
3.2.4 Adding Lights and Cameras	
3.2.5 Drawing a Path.....	
3.2.6 Creating an Interactive Path	
3.2.7 Controlling the Camera's Speed on the Path	
3.2.8 Switching between Path Camera and Free Camera.....	
3.2.9 Creating Interactive Textures	
3.2.10 Adding an Additional Top View Helps to Keep Track of the Locations of Cameras on the Circuit	
Chapter 6	
Virtual Cameras	
1 Introduction.....	
1.1 Relationships between Virtual Cameras and the Environment of a Scene	
1.2 The Psychology of the Viewer.....	
1.3 Cameras are Rarely Working Alone.....	
2 Building Virtual Cameras.....	
2.1 Motion Stabilization	
2.2 Virtual Cinematography.....	
2.2.1 Character-Dependent Camera	
2.2.2 Camera System Independent from Characters ...	
3 How to Design Behaviors for Interactive Cameras that Produce the Same Effect as Cameras Found in Movies.....	
3.1 Notes about <i>Rear Window</i> by Alfred Hitchcock.....	
3.2 The Design of the Hitch Camera	
3.2 Notes about <i>Paths of Glory</i> by Stanley Kubrick	
3.4 The Design of a Maze Camera	
3.5 Notes about <i>L'Avventura</i> by Antonioni.....	
4 Conclusion	
<i>Table of Contents ix</i>	
FM.qxd 12/11/04 12:13 PM Page ix	
Chapter 7	
Advanced Virtual Cameras and Their Environments	
1 Conceptual Design	
1.1 Step 1: Conceptual Design	
1.2 Step 2: Cameras and Navigation	
1.3 Step 3: The Following Questions Are Related to the Viewer's Experience.....	
2 Advanced Virtual Camera Development for the Diner Project.	
2.1 Step 1: Diner: Conceptual Design	

2.2 Step 2: Cameras and Ways to Navigate Inside the Virtual World.....	
2.3 Step 3: The Viewer's Experience.....	
3 Virtual Camera Development for Nighthawks.....	
3.1 Step 1: Conceptual Design	
3.2 Step 2: Cameras and Navigation	
3.3 Step 3: User Experience	
4 Virtual Archeology at Aphrodisias 2003.....	
5 Conclusion	
Chapter 8	
The Viewer's Experience, Interactive Installations, and Displays ...	
1 The Viewer's Interaction.....	
2 Serial Input Devices.....	
2.1 Technological Path for Serial Input Devices for a Virtual World.....	
2.2 An Example of Virtual Space Installation Using an Ultrasound Sensor	
2.3 Passing Variables from the Outside World Inside Virtools ...	
2.4 Embedding a Virtools Scene Inside a Director Movie	
2.5 Serial Communication.....	
2.6 Sensors	
2.7 Using Active X with Microsoft Visual Basic®	
3 Using a Telephone as an Input Device	
3.1 Technological Path	
3.2 An Example of a Virtual Space Installation Using a Telephone in Virtools.....	
4 Musical Instrument Digital Interface	
4.1 Setting Up MIDI Channels	
4.2 Virtools and Max Configuration.....	
5 Data Glove	
6 Infrared Sensors and Mouse-Driven Devices.....	
7 Game Controller	
8 Sound as an Input Device	
8.1 Using a Threshold	
8.2 Sampling Sound	
9 Navigation	
9.1 Example of Process	
9.2 Interface Design and Content Management.....	
9.2.1 Static Interfaces—Creating a Push Button and a Mouse Rollover	
9.2.2 Dynamic Interfaces—Examples of 3D Interfaces	
9.2.3 How to Create a 3D Mouse Pointer.....	
9.2.4 How to Create an Interface Design for a 3D Character	
10 Displays	
10.1 Multiscreen Displays	
10.2 Split View with Two Rendering Windows	
10.3 Comics Split Views.....	
10.4 Multiple Screens Display	
11 Conclusion	
Bibliography.....	