Table of Contents

Chapter One Fundamentals of Lighting Design	1
Motivation	2
Off-Screen Space	2
Qualities of Light	3
Direct and Indirect Light	5
Cheating	5
Cheating in Live Action	8
Visual Goals of Lighting Design	8
Making Things Read	9
Making Things Believable	9
Enhancing Shaders and Effects	10
Maintaining Continuity	10
Directing the Viewer's Eye	11
Emotional Impact	11
Lighting Challenges	12
Your Workspace	14
Creative Control	15
Chapter Two Lighting Basics and Good Practices	17
Chapter Two Lighting Basics and Good Practices Starting Points	17
Starting Points	18
Starting Points Types of Lights	18 19 19 20
Starting Points Types of Lights Point Lights	18 19 19 20 23
Starting Points Types of Lights Point Lights Spotlights	18 19 19 20 23 24
Starting Points Types of Lights Point Lights Spotlights Directional Lights	18 19 19 20 23 24 26
Starting Points Types of Lights Point Lights Spotlights Directional Lights Area Lights	18 19 19 20 23 24 26 27
Starting Points Types of Lights Point Lights Spotlights Directional Lights Area Lights Models Serving as Lights	18 19 19 20 23 24 26
Starting Points Types of Lights Point Lights Spotlights Directional Lights Area Lights Models Serving as Lights Environment Spheres	18 19 19 20 23 24 26 27
Starting Points Types of Lights Point Lights Spotlights Directional Lights Area Lights Models Serving as Lights Environment Spheres Ambient Light	18 19 19 20 23 24 26 27 27 29
Starting Points Types of Lights Point Lights Spotlights Directional Lights Area Lights Models Serving as Lights Environment Spheres Ambient Light Controls and Options	18 19 19 20 23 24 26 27 27 29 29
Starting Points Types of Lights Point Lights Spotlights Directional Lights Area Lights Models Serving as Lights Environment Spheres Ambient Light Controls and Options Decay	18 19 19 20 23 24 26 27 27 29

Lighting in Production	38
When to Light	38
The Feedback Loop	38
Naming Lights	40
Managing Versions	40
Exercises	41
Chapter Three Shadows and Occlusion	43
The Visual Functions of Shadows	44
Defining Spatial Relationships	44
Revealing Alternate Angles	45
Enhancing Composition	46
Adding Contrast	46
Indicating Off-Screen Space	47
Integrating Elements	48
Which Lights Need Shadows?	49
Shadow Clutter	49
Secondary Shadows	50
Shadow Color	51
Testing Shadows	52
Shadow Size and Perspective	53
Shadow Algorithms	55
Depth Map Shadows	55
Raytraced Shadows	62
Hard and Soft Shadows	65
Hard and Soft Light	67
Soft Shadows with Depth Maps	68
Soft Raytraced Shadows	70
Occlusion	73
Ambient Occlusion	73
Occlusion in Global Illumination	74
Other Types of Occlusion	76
Faking Shadows	77
Negative Lights	77
Shadows-Only Lights	78

vi Digital Lighting and Rendering

Shadow Objects	80
Baking Lighting	81
Conclusions	83
Exercises	83
Chapter Four Lighting Environments and	
Architecture	85
Daylight	86
Sunlight	86
Sky Light	89
Indirect Light	92
Night Scenes	94
Practical Lights	96
Lighting the Light	96
Set Lighting from Practical Lights	97
Lighting Windows	99
Simulating Indirect Light	101
Corners	105
Sourcy Lighting	107
Global Illumination	108
Conventional Radiosity	112
Photon Mapping	113
Final Gathering	115
Caustics	116
Ambient Occlusion	120
Exercises	123
Chapter Five Lighting Creatures, Characters,	
and Animation	125
Modeling with Light	126
Directionality	127
Definition	128
Three-Point Lighting	131
Variations	133
Tools, Not Rules	134
Functions of Lights	134
Key Lights	135

Fill Lights	136
Bounce Lights	139
Rim Lights	140
Kickers	144
Specular Lights	145
Issues in Lighting Character Animation	146
Test Frames	147
Linking Lights to Characters	147
Technology Changes	148
Subsurface Scattering	150
Lighting Hair	153
Lighting Eyes	154
Exercises	157
Chapter Six Cameras and Exposure	159
Understanding F-Stops and Depth of Field	160
Matching Real Lenses	162
The Two-Thirds Rule	163
Hyperfocal Distance	163
Bokeh Effects	164
Frame Rates	165
Realistic Motion Blur	165
Shutter Speed and Shutter Angle	165
The Comet Tail Myth	168
Blurring Rotations	169
Video Fields	170
Film Speed	172
Photographic Exposure	173
The Zone System	174
Histograms	175
Matching Lens Imperfections	177
Lens Distortion	177
Chromatic Aberration	180
Vignetting	180
Lens Flares and Halation	181
Exercises	182

Chapter Seven Composition and Staging	185
Types of Shots	186
Shot Sizes	186
Z-Axis Blocking	188
POV Shots	188
The Two-Shot	189
The Over-the-Shoulder Shot	190
Camera Angles	191
The Line of Action	191
Perspective	192
High-Angle and Low-Angle Shots	195
Camera Moves	196
Improving Your Composition	198
The Rule of Thirds	199
Positive and Negative Space	200
Graphic Weight	201
Lines	202
Tangencies	203
Framing for Film and Video	204
Formats and Aspect Ratios	204
Film Formats	205
Adaptation to Television	208
Cropping and Overscan	209
Exercises	210
Chapter Eight The Art and Science of Color	213
Color Mixing	214
Additive Color	214
Subtractive Color	215
Hue, Saturation, and Value Adjustments	216
When Light Color Meets Surface Color	217
Color Schemes	220
Color Contrast	221
Meanings of Colors	224
Color and Depth	227
Tinted Black-and-White Images	228

Color Balance	229
Color Temperature	231
Picking Colors from Pictures	236
Understanding RGB Color	237
Importance of Red, Green, and Blue	239
Digital Color	240
8-bit Color	240
16-bit Color	241
HDRI	241
Compact Data Formats	243
Exercises	245
Chapter Nine Shaders and Rendering Algorithms	247
Shading Surfaces	248
Diffuse, Glossy, and Specular Reflection	248
Specular Highlights	251
BRDF and BSSRDF	258
Anti-Aliasing	259
Over-Sampling	259
Under-Sampling	262
Filtering	263
Rendering at Higher Resolutions	263
Raytracing	264
Raytracing Acceleration Structures	265
Raytraced Reflections	266
Shadows	269
Transparency and Refraction	270
Reyes Algorithms	274
The Renderman Interface Standard	275
Reyes and Raytracing	276
Z-Buffer Rendering	277
Scanline Rendering	277
GPU-Accelerated and Hardware Rendering	278
Hardware Rendering	278
GPU Acceleration	278
Interactive Previewing	279
Exercises	280

x Digital Lighting and Rendering

Chapter Ten	Designing and Assigning Textures	283
Types of Tex	xture Mapping	284
	Mapping	284
	nr Mapping	286
100	escence Mapping	287
Transpa	nrency Mapping	288
Displac	ement Mapping	290
Bump N	Mapping	291
	l Mapping	293
Polyno	mial Texture Mapping	295
Other 1	Mapping Techniques	295
Photograph	aic Textures	296
Shooti	ng Tips	296
Flatbec	1 Scans	299
Stylized Te	xtures	299
Texture Ma	ap Resolution	302
Alignment	Strategies	304
Tiling	Maps	304
Decals		310
Project	tions	313
UV Co	oordinates	317
Textur	ing Poles	321
3D Pai	nt Programs	323
Procedural	Textures	324
Resolu	ition Independence	324
3D Te	xtures	324
Anima	ation	325
Appea		325
Baking	g Procedural Textures into Texture Maps	326
Looks Dev	relopment	328
Painti	ng in Layers	328
Color	First	329
Displa	cement First	330
Exercises		332

Chapter Eleven Rendering Passes and	
Compositing	335
Rendering in Layers	336
Background Layers	337
Matte Objects	338
Effects Layers	339
Alpha Channel Issues	342
Compositing With Straight Alpha Cha	nnels 343
Compositing With Premultiplied Alpha	a Channels 345
Rendering in Passes	347
Diffuse Passes	348
Specular Passes	349
Reflection Passes	350
Shadow Passes	353
Ambient Passes	358
Occlusion Passes	359
Beauty Passes	360
Global Illumination Passes	361
Mask Passes	362
Depth Passes	363
Pass Management Features	365
Rendering Many Passes at Once	366
Lighting in the Composite	366
Rendering Lights as Separate Passes	367
Relighting Tools	368
Matching Live-Action Background Plates	369
Reference Balls and Light Probes	370
Other Approaches to Matching Lightin	
Exercises	375
Chapter Twelve Production Pipelines	and
Professional Practices	377
Production Pipelines	378
Planning an Animated Feature	378
Story	378
Layout	379

xii Digital Lighting and Rendering

Index

Preparing for Visual Effects Shots	380
Previsualization	380
Match Move and Virtual Sets	381
Rotoscoping	383
Core Departments	384
Art Department	385
Modeling	386
Set Decorating	387
Technical Directors	388
Character Rigging	389
Character Animation	390
Effects	390
Shading	391
Texture Paint	392
Lighting	393
Compositing	394
Film I/O	395
Visualizing Production Pipelines	395
Getting Work Approved	397
Working with Clients	397
Setting Expectations	397
Dealing with Changes	398
Supervising Lighters	399
The Chain of Command	400
Getting a Job in 3D Lighting	400
A Lighting Showreel	401
Credits	402
Quality over Quantity	403
Starting Strong	403
Do I Need to Specialize?	404
Internal Promotion	405
Job Security	406
Advancing in Your Career	407

409