

1. Record Nr.	UNINA9910830756703321
Autore	Koshel R. John
Titolo	Illumination engineering : design with nonimaging optics / / John Koshel
Pubbl/distr/stampa	Hoboken, New Jersey : , : Wiley-IEEE Press, , 2013 [Piscataqay, New Jersey] : , : IEEE Xplore, , [2013]
ISBN	1-118-46249-1 1-118-46245-9
Descrizione fisica	1 online resource (326 p.)
Classificazione	TEC030000
Disciplina	621.36
Soggetti	Optical engineering Lighting
Lingua di pubblicazione	Inglese
Formato	Materiale a stampa
Livello bibliografico	Monografia
Note generali	Description based upon print version of record.
Nota di bibliografia	Includes bibliographical references and index.
Nota di contenuto	PREFACE xiii -- CONTRIBUTORS xvii -- GLOSSARY xix -- CHAPTER 1 INTRODUCTION AND TERMINOLOGY 1 -- 1.1 What Is Illumination? 1 -- 1.2 A Brief History of Illumination Optics 2 -- 1.3 Units 4 -- 1.3.1 Radiometric Quantities 4 -- 1.3.2 Photometric Quantities 6 -- 1.4 Intensity 9 -- 1.5 Illuminance and Irradiance 10 -- 1.6 Luminance and Radiance 11 -- 1.6.1 Lambertian 13 -- 1.6.2 Isotropic 14 -- 1.7 Important Factors in Illumination Design 15 -- 1.7.1 Transfer Efficiency 15 -- 1.7.2 Uniformity of Illumination Distribution 16 -- 1.8 Standard Optics Used in Illumination Engineering 17 -- 1.8.1 Refractive Optics 18 -- 1.8.2 Reflective Optics 20 -- 1.8.3 TIR Optics 22 -- 1.8.4 Scattering Optics 24 -- 1.8.5 Hybrid Optics 24 -- 1.9 The Process of Illumination System Design 25 -- 1.10 Is Illumination Engineering Hard? 28 -- 1.11 Format for Succeeding Chapters 29 -- References 30 -- CHAPTER 2 ƒETENDUE 31 -- 2.1 ƒEtendue 32 -- 2.2 Conservation of ƒEtendue 33 -- 2.2.1 Proof of Conservation of Radiance and ƒEtendue 34 -- 2.2.2 Proof of Conservation of Generalized ƒEtendue 36 -- 2.2.3 Conservation of ƒEtendue from the Laws of Thermodynamics 40 -- 2.3 Other Expressions for ƒEtendue 41 -- 2.3.1 Radiance, Luminance, and Brightness 41 -- 2.3.2 Throughput 42 -- 2.3.3 Extent 43 -- 2.3.4 Lagrange Invariant 43 -- 2.3.5 Abbe Sine Condition 43 -- 2.3.6 Confi

guration or Shape Factor 44 -- 2.4 Design Examples Using Etendue 45 -- 2.4.1 Lambertian, Spatially Uniform Disk Emitter 45 -- 2.4.2 Isotropic, Spatially Uniform Disk Emitter 48 -- 2.4.3 Isotropic, Spatially Nonuniform Disk Emitter 50 -- 2.4.4 Tubular Emitter 52 -- 2.5 Concentration Ratio 59 -- 2.6 Rotational Skew Invariant 61 -- 2.6.1 Proof of Skew Invariance 61 -- 2.6.2 Refined Tubular Emitter Example 63 -- 2.7 Etendue Discussion 67 -- References 68 -- CHAPTER 3 SQUEEZING THE ETENDUE 71 -- 3.1 Introduction 71 -- 3.2 Etendue Squeezers versus Etendue Rotators 71 -- 3.2.1 Etendue Rotating Mappings 74 -- 3.2.2 Etendue Squeezing Mappings 77.

3.3 Introductory Example of Etendue Squeezer 79 -- 3.3.1 Increasing the Number of Lenticular Elements 80 -- 3.4 Canonical Etendue-Squeezing with Afocal Lenslet Arrays 82 -- 3.4.1 Squeezing a Collimated Beam 82 -- 3.4.2 Other Afocal Designs 83 -- 3.4.3 Etendue-Squeezing Lenslet Arrays with Other Squeeze-Factors 85 -- 3.5 Application to a Two Freeform Mirror Condenser 88 -- 3.6 Etendue Squeezing in Optical Manifolds 95 -- 3.7 Conclusions 95 -- Appendix 3.A Galilean Afocal System 96 -- Appendix 3.B Keplerian Afocal System 98 -- References 99 -- CHAPTER 4 SMS 3D DESIGN METHOD 101 -- 4.1 Introduction 101 -- 4.2 State of the Art of Freeform Optical Design Methods 101 -- 4.3. SMS 3D Statement of the Optical Problem 103 -- 4.4 SMS Chains 104 -- 4.4.1 SMS Chain Generation 105 -- 4.4.2 Conditions 106 -- 4.5 SMS Surfaces 106 -- 4.5.1 SMS Ribs 107 -- 4.5.2 SMS Skinning 108 -- 4.5.3 Choosing the Seed Rib 109 -- 4.6 Design Examples 109 -- 4.6.1 SMS Design with a Prescribed Seed Rib 110 -- 4.6.2 SMS Design with an SMS Spine as Seed Rib 111 -- 4.6.3 Design of a Lens (RR) with Thin Edge 115 -- 4.6.4 Design of an XX Condenser for a Cylindrical Source 117 -- 4.6.5 Freeform XR for Photovoltaics Applications 129 -- 4.6.5.1 The XR Design Procedure 131 -- 4.6.5.2 Results of Ray Tracing Analysis 135 -- 4.7 Conclusions 140 -- References 144 -- CHAPTER 5 SOLAR CONCENTRATORS 147 -- 5.1 Concentrated Solar Radiation 147 -- 5.2 Acceptance Angle 148 -- 5.3 Imaging and Nonimaging Concentrators 156 -- 5.4 Limit Case of infinitesimal Etendue: Aplanatic Optics 164 -- 5.5 3D Minano-Benitez Design Method Applied to High Solar Concentration 171 -- 5.6 K_Aohler Integration in One Direction 180 -- 5.7 K_Aohler Integration in Two Directions 195 -- 5.8 Appendix 5.A Acceptance Angle of Square Concentrators 201 -- 5.9 Appendix 5.B Polychromatic Efficiency 204 -- Acknowledgments 207 -- References 207 -- CHAPTER 6 LIGHTPIPE DESIGN 209 -- 6.1 Background and Terminology 209 -- 6.1.1 What is a Lightpipe 209. 6.1.2 Lightpipe History 210 -- 6.2 Lightpipe System Elements 211 -- 6.2.1 Source/Coupling 211 -- 6.2.2 Distribution/Transport 211 -- 6.2.3 Delivery/Output 212 -- 6.3 Lightpipe Ray Tracing 212 -- 6.3.1 TIR 212 -- 6.3.2 Ray Propagation 212 -- 6.4 Charting 213 -- 6.5 Bends 214 -- 6.5.1 Bent Lightpipe: Circular Bend 214 -- 6.5.1.1 Setup and Background 214 -- 6.5.2 Bend Index for No Leakage 215 -- 6.5.3 Reflection at the Output Face 216 -- 6.5.4 Reflected Flux for a Specific Bend 217 -- 6.5.5 Loss Because of an Increase in NA 218 -- 6.5.6 Other Bends 219 -- 6.6 Mixing Rods 220 -- 6.6.1 Overview 220 -- 6.6.2 Why Some Shapes Provide Uniformity 221 -- 6.6.3 Design Factors Influencing Uniformity 223 -- 6.6.3.1 Length 223 -- 6.6.3.2 Solid versus Hollow 223 -- 6.6.3.3 Periodic Distributions 224 -- 6.6.3.4 Coherence 224 -- 6.6.3.5 Angular Uniformity 224 -- 6.6.3.6 Circular Mixer with Ripples 225 -- 6.6.4 RGB LEDs 226 -- 6.6.4.1 RGB LEDs with Square Mixers 226 -- 6.6.4.2 RGB LEDs with Circular Mixers 227 -- 6.6.5 Tapered Mixers 228 -- 6.6.5.1 Length 229 -- 6.6.5.2 Straight

Taper Plus Lens 229 -- 6.6.5.3 Angular Uniformity 231 -- 6.6.5.4
Straight + Diffuser + Taper 232 -- 6.7 Backlights 233 -- 6.7.1
Introduction 233 -- 6.7.2 Backlight Overview 234 -- 6.7.3
Optimization 235 -- 6.7.4 Parameterization 235 -- 6.7.4.1 Vary
Number 236 -- 6.7.4.2 Vary Size 236 -- 6.7.5 Peak Density 237 --
6.7.6 Merit Function 237 -- 6.7.7 Algorithm 238 -- 6.7.8 Examples
239 -- 6.7.8.1 Peaked Target Distribution 239 -- 6.7.8.2 Border
Extractors 240 -- 6.7.8.3 Input Surface Texturing 241 -- 6.7.8.4
Variable Depth Extractors 242 -- 6.7.8.5 Inverted 3D Texture Structure
242 -- 6.7.8.6 Key Pads 244 -- 6.8 Nonuniform Lightpipe Shapes 245
-- 6.9 Rod Luminaire 246 -- Acknowledgments 247 -- References 247
-- CHAPTER 7 SAMPLING, OPTIMIZATION, AND TOLERANCING 251 --
7.1 Introduction 251 -- 7.2 Design Tricks 253 -- 7.2.1 Monte Carlo
Processes 254 -- 7.2.1.1 Monte Carlo Sources 254 -- 7.2.1.2 Monte
Carlo Ray Tracing 255.
7.2.2 Reverse Ray Tracing 257 -- 7.2.3 Importance Sampling 260 --
7.2.4 Far-Field Irradiance 263 -- 7.3 Ray Sampling Theory 266 -- 7.3.1
Transfer Efficiency Determination 266 -- 7.3.2 Distribution
Determination: Rose Model 268 -- 7.4 Optimization 272 -- 7.4.1
Geometrical Complexity 273 -- 7.4.1.1 CAD Geometry 274 -- 7.4.1.2
Variables and Parameterization 275 -- 7.4.1.3 Object Overlap,
Interference, Linking, and Mapping 277 -- 7.4.2 Merit Function
Designation and Calculation 280 -- 7.4.3 Optimization Methods 281 --
7.4.4 Fractional Optimization with Example: LED Collimator 282 -- 7.5
Tolerancing 289 -- 7.5.1 Types of Errors 290 -- 7.5.2 System Error
Sensitivity Analysis: LED Die Position Offset 290 -- 7.5.3 Process Error
Case Study: Injection Molding 291 -- References 297 -- INDEX 299.

Sommario/riassunto

"This book brings together experts in the field who present material on a number of important and growing topics including lighting, displays, solar concentrators. The first chapter provides an overview of the field of nonimaging and illumination optics. Included in this chapter are terminology, units, definitions, and descriptions of the optical components used in illumination systems. The next two chapters provide material within the theoretical domain, including etendue, etendue squeezing, and the skew invariant. The remaining chapters focus on growing applications. This entire field of nonimaging optics is an evolving field, and the editor plans to update the technological progress every two to three years. The editor, John Koshel, is one of the most prominent leading experts in this field, and he is the right expert to perform the task"--

"Provides a wide number of topics so that practicing engineers and scientist can expand their knowledge into other subfields within nonimaging and illumination optics"--
