Physically Based Rendering

FROM THEORY TO IMPLEMENTATION

This book was typeset with TEX, using the ZzTEX macro package on the Microsoft Windows XP platform. The main body of the text is set in Minion at 9.5/12, and the margin indices are set in Bitstream Letter Gothic 12 Pitch at 5.5/7. Chapter titles are set in East Bloc ICG Open and Univers Black. Cholla Sans Bold is used for other display headings.

The manuscript for this book is written in `pyweb`, a literate programming markup format of the authors' own design. This input format is based heavily on the `noweb` system developed by Norman Ramsey. The `pyweb` scripts simultaneously generate the TEX input for the book as well as the source code of the `pbrt` system.

In addition, these scripts semi-automatically generate the code identifier cross-references that appears in the margin indices. Wherever possible, these indices are produced automatically by parsing the source code itself. Otherwise, usage and definition locations are marked explicitly in the `pyweb` input, and these special marks are removed before either the book or the code is generated. These scripts were originally written by the authors, and subsequently rewritten by Paul Anagnostopoulos in Gossip to integrate into the ZzTEX package.

Overall, the book comprises over 90,000 lines of `pyweb` input, or nearly 5 megabytes of text. The cover image, example renderings, and chapter images were generated by `pbrt`, the software that is described in this book.

Index of Notation

p	Point in 3D space	56
$\mathbf{v}$	Direction vector in 3D space	56
p_x, $\mathbf{v}_x$	x component of point / vector	57
$\mathbf{v} \cdot \mathbf{w}$	Dot product of vectors $\mathbf{v}$ and $\mathbf{w}$	60
$\|\|\mathbf{v}\|\|$	Length of vector $\mathbf{v}$	61
$\mathbf{v} \times \mathbf{w}$	Cross product of vectors $\mathbf{v}$ and $\mathbf{w}$	61
$\hat{\mathbf{v}}$	Normalized vector $\mathbf{v}$	62
$\mathbf{T}$, $\mathbf{M}$	Linear transformation (4×4 matrix)	74
$\mathbf{q}$	Quaternion	92
(u, v)	2D parametric coordinates of point on surface	101
λ	Wavelength of light	261
$X(\lambda)/Y(\lambda)/Z(\lambda)$	XYZ spectral matching curves	270
Φ	Radiant flux (power)	282
E	Irradiance (flux area density)	282
M	Radiant exitance (flux area density)	282
ω	Normalized vector on the unit sphere	284
I	Radiant intensity (flux density per solid angle)	285
L	Radiance (flux density per area per solid angle)	285
$L_\mathrm{i}(\mathrm{p}, \omega)/L_\mathrm{o}(\mathrm{p}, \omega)$	Incident and exitant radiance functions	286
Y	Luminance	287
Ω	Set of directions on the unit sphere	288
$\mathcal{H}^2(\mathbf{n})$	Hemisphere about surface normal $\mathbf{n}$	288
$f_\mathrm{r}(\omega_\mathrm{i}, \omega_\mathrm{o})$	BRDF (bidirectional reflectance distribution function)	295
$f(\omega_\mathrm{o}, \omega_\mathrm{i})$	BSDF (bidirectional scattering distribution function)	296
$\mathbb{S}^2$	Sphere of directions	296
$S(\mathrm{p}_\mathrm{o}, \omega_\mathrm{o}, \mathrm{p}_\mathrm{i}, \omega_\mathrm{i})$	BSSRDF (bidirectional scattering-surface reflectance distribution function)	296
$F(\omega)$	Frequency-space representation of function $f(x)$	326
$\delta(x)$	Dirac delta distribution	327
$\mathrm{III}_T(x)$	Shah function with period T	327
$\otimes$	Convolution operation	327
$\Pi_T(x)$	Box function with period T	329
$\Phi_b(n)$	Radical inverse function, base b	361
$\rho_\mathrm{hd}(\omega)$	Hemispherical-directional reflectance	430
ρ_hh	Hemispherical-hemispherical reflectance	430
η_i, η_o	Index of refraction (incident and outgoing media)	432
F_r	Fresnel reflectance	435
k	Absorption coefficient	435
ω_h	Half-angle vector	452
$D(\omega_\mathrm{h})$	Microfacet distribution function	452

Index of Notation