References


17. Lambda Research Corporation, “OSLO.” computer software.

18. ZEMAX Development Corporation, “ZEMAX.” computer software.


References

33. J. A. Rubio, A. Belmonte, and A. Comerón, “Numerical simulation of long-

34. X. Deng, B. Bihari, J. Gan, F. Zhao, and R. T. Chen, “Fast algorithm for

35. S. Coy, “Choosing mesh spacings and mesh dimensions for wave optics sim-

36. C. Rydberg and J. Bengtsson, “Efficient numerical representation of the op-
tical field for the propagation of partially coherent radiation with a specified

37. D. G. Voelz and M. C. Roggemann, “Digital simulation of scalar optical diffrac-

38. M. Nazarathy and J. Shamir, “Fourier optics described by operator algebra,”

39. M. Nazarathy and J. Shamir, “First-order optics—a canonical operator repre-


41. R. A. Johnston and R. G. Lane, “Modeling scintillation from an aperiodic

42. J. D. Mansell, R. Praus, and S. Coy, “Determining wave-optics mesh parame-

43. J. M. Martin and S. M. Flatté, “Intensity images and statistics from numerical
simulation of wave propagation in 3-D random media,” Appl. Opt. 27(11),

44. J. M. Martin and S. M. Flatté, “Simulation of point-source scintillation through

Benjamin Cummings (2006).

46. C. Palma and V. Bagini, “Extension of the Fresnel transform to ABCD sys-

47. A. J. Lambert and D. Fraser, “Linear systems approach to simulating optical


Index

aberrations
general, 65
RMS wavefront, 75
Siedel, 66
Zernike polynomials, 66
absorbing boundary, 134
adaptive optics, 73
aliasing, 23, 26, 30, 52, 57, 107, 110,
115, 120, 122, 124, 133, 141, 172
Ampère’s law, 3–5
apodization, 66
borosilicate crown glass (BK7), 84
charge, 2
elementary, 2
coherence diameter, 158, 159, 164
coherence factor, 158, 159, 175, 179,
181, 184
coherence radius, 159
continuity equation, 2
convolution, 39
in diffraction, 15, 104
in imaging, 77, 79
in one dimension, 41
in two dimensions, 42
integral, 40
theorem, 41, 43, 99
correlation, 43
integral, 43
theorem, 43
Coulomb’s law, 4
current
free current density, 2, 5
deformable mirror, 73
derivative, 51, 54
diffraction, 9
Fraunhofer, 11, 13, 55, 58
Fraunhofer approximation, 11, 55
Fresnel, 9
angular spectrum computation,
95
convolution form, 88
convolution integral, 88
FT form, 88, 116
one-step computation, 90
Talbot imaging, 113
two-step computation, 92
generalized Huygens-Fresnel in-
tegral, 104
Dirac delta function, 12, 107, 185
electric permittivity, 5
electric susceptibility, 5
Faraday’s law, 3–5
Fourier transform
forward
continuous, 15
discrete, 11, 16
fractional, 104
inverse
continuous, 15
discrete, 17
two-dimensional, 35
geometric optics, 1
lensmaker’s equation, 103
ray matrices, 102
ray transfer, 103
Snell’s law, 103
thin lens, 103
gradient, 50, 52–54

Helmholtz equation, 7

imaging
  coherent, 77
  general, 77
  incoherent, 79
inner scale, 155
isoplanatic angle, 158, 163, 164

lenses
  phase retardance, 58
  pupil function, 66
log-amplitude variance, 163, 164, 179
Lorentz force law, 2

magnetic permeability, 5
magnetic susceptibility, 5
magnetization density, 2
Maxwell’s equations, 1, 3–5, 156
mutual coherence function, 158

normalized aperture coordinates, 66
Nyquist sampling criterion, 21, 23, 31, 32, 115, 123
Nyquist sampling frequency, 21

operator notation, 89
outer scale, 155

paraxial approximation, 8
point source, 65, 107, 110, 146, 159, 175, 180, 183
  model, 107–112, 175, 177, 178, 181
polarization density, 2
power spectral density, 166
  phase, 158
  refractive index, 155
probability density function (PDF), 44
pupil
  entrance, 65
  exit, 65

Rytov method, 157, 163

Sellmeier equation, 84
signal
  Gaussian, 31
  Gaussian, quadratic phase, 33
  sinc, 30
spatial frequency, 122
Strehl ratio, 82
structure function, 47, 48, 50, 153, 166, 181, 184
  of phase screen, 181
  phase, 158, 163, 172, 181
  potential temperature, 153
  refractive index, 154
  velocity, 153
  wave, 158, 160, 179
structure parameter
  potential temperature, 153
  refractive index, 154, 158
  velocity, 153
super-Gaussian, 134, 137, 146

Taylor frozen-turbulence hypothesis, 155

wave
  Gaussian beam, 7, 9, 113, 157
  planar, 7, 9, 11, 13, 157, 163
  spherical, 7–9, 12, 61, 65, 108, 116, 118, 141, 157, 159, 163
wave equation, 6, 157
wavefront sensor, 73
wavelength, 1, 7, 55, 84, 85
Whittaker-Shannon sampling theorem, 21
Jason D. Schmidt is a Major in the U.S. Air Force and an assistant professor of electro-optics at the Air Force Institute of Technology in the Department of Electrical and Computer Engineering. Previously, he was a research physicist at the U.S. Air Force Research Laboratory’s Starfire Optical Range. He received the doctoral degree in Electro-Optics from the University of Dayton. Dr. Schmidt has been an active researcher in optical wave propagation through atmospheric turbulence for ten years. He received the Young Investigator Award in 2008 from the Air Force Office of Scientific Research. Besides optical wave propagation, Dr. Schmidt’s research interests include free-space optical communications and adaptive optics.