Aberration function, 499
Aberration, spherical of aspherical surfaces, 839
Aberration function
secondary, 504
Schwarzschild, 504
Aberrations, 83, 259, 348, 408, 410, 416
astigmatism of a concave mirror, 841
balanced, 506, 508
coma of a concave mirror, 840
detection with Foucault test, 283
moire pattern of, 766
primary Zernike, 521
rotationally symmetric pupil, 499
Seidel, 513
separation, 259
lateral, 504
variance, 507, 508, 535
Absolute testing
of flats, 40
of spherical surfaces, 72, 665
Accuracy in double-pass interferometers, 264
Adaptive compensator, 471
Airy pattern, 400
isophots, 404, 406
normalized intensity, 400
Aldis spherometer, 817
Angle block, 809
Angle measurement, 808
interferometric, 812
in prisms, 813
Angle vise, 809
Annular polynomials, 525
Armitage and Lohmann interferometer, 209
Aspheric lens testing, 839
Aspheric surface, 15, 102, 327, 435
astigmatism of, 841
caucic of, 837, 838
coma of, 840
definition, 832
spherical aberration of, 839
testing, 444, 452
Aspheric wavefront, 435
testing with sub-Nyquest interferometry, 631
testing with two wavelengths, 488, 635
testing with wavefront stitching, 491, 637
testing methods, 437, 629, 631, 635, 637
Astigmatic surfaces, 841
comparison, 847
testing, 846
Astigmatism
axial, 504
detection, 841
detection with Foucault test, 287
Atomic force microscopes, 678, 683
Autocollimation, 443
Autocollimation test for parabolic mirrors, 363
Autocollimator, 810, 821
Axial astigmatism, 504
Axial coma, 504
Axicon surface, 834
Babinet compensator, 163
Beam splitter, 48, 49, 51, 58
diffraction grating, 79, 80
birefringent, 104
non-polarizing, 55
polarizing, 53
required accuracy, 51
Saunders, 114
Wollaston prism, 106
Beam walk-off, 269
Bevel gauge, 816
Brewster's angle, 48
Brown interferometer, 192
Burch compensator, 456
Burch interferometer, 98
Cartesian configuration, 451
Caustic, 300, 837, 838
Circle polynomials, 505
Circular grid test, 347
Cliromatic confocal microscopy, 693
Coddington equations, 311
Coded light projection, 780
Coherence, 123
  in radial shear interferometer, 191
    requirements, 9, 20, 22, 56, 262
Coma aberration detection, 284, 840
Coma, axial, 504
Commercial interferometers, 25, 735
Common path interferometer, 97, 118
Compensator, 454
  adaptive, 471
Burch, 456
Couder, 456
Dall, 458
holographic, 474
Offner, 462
Offner reflection, 462
refractive, 461
reflecting, 466
Ross, 456
Shafer, 464
Computer generated holograms, 478, 483, 485
Concave mirror
  astigmatism of, 841
  coma of, 840
Confocal microscopy, 668, 689, 693
Confocal cavity, 270, 821
Conic constant, 833
Conic surface
  aberration of the normals, 836
    definition, 832
  parameters for, 835
Contact profilometers, 668, 670
Couder compensator, 456
Couder screen, 293
Cube corner prism, 28, 66
Curvature: measurement, 421
  Curvatures, local average, 421
  Cyclic radial shear interferometer, 194
  Cyclic interferometer, 140
  Cylindrical surfaces: testing, 453
Dall compensator, 458
Descartes ellipsoid, 450
Descartes hyperboloid, 450
Detectors, 613, 614
Differential interference contrast
  microscope, 736
Diffraction based interferometer, 158
Diffraction ruling, 64
Digital holography, 791, 794
Digital holographic interferometry, 791
Directional shearing interferometer, 166
Displacement measurement, 781
Divided circle, 808
Double-focus interferometer, 112
Double-focus system, 107
Double-pass interferometer, 259
  Fizeau, 262, 263, 269
  Twyman-Green, 264
radial shear interferometer, 195
Dyson system, 441
Dyson interferometer, 112
Electro-optic holography, 795
Ellipsoidal surface
  cross section, 845
  definition, 835, 842
  testing, 444, 448
Encircled Energy, 402
Equal chromatic order fringes, 220, 232
Equivalent wavelength, 759
ESPI (Electronic speckle pattern interferometry), 791, 794
Fabry–Perot interferometer, 219, 236
Film and plate thickness measurement, 729, 735
First order parameters for an interferometer, 186
Fitting the wavefront, 498
Fizeau interferometer, 1, 229, 553
Fizeau interferometer, double-pass, 262, 269
Flat surface
  and Ritchey-Common test, 310
  testing, 4, 40, 237, 442
Flatness measurement, 4, 40, 237
Flats, 4, 7, 10, 11
  absolute testing of, 40
  liquid, 23
Focal length measurement, 823
  fiber optics, 827
  Fourier transforms, 827
  microlenses, 827
  moiré, 825
  nodal slide bench, 823
  Talbot autoimages, 826
Focimeters, 824
Foucault test, 275
  geometrical theory, 280
  physical theory, 289
  practical configurations, 280
  with Couder screen, 293
  with zonal test, 293
Fourier transforms, 422
Fresnel zone plate interferometer, 102
Fringes
  equal chromatic order (FECO), 220, 232
  projection, 756, 769
  stabilization, 77
  Tolansky, 241
Gardner-Bennett test, 393
Gates reversal shear interferometer, 214
Gaussian beam, 399, 409
Geneva gauge, 820
Geometrical phase shifting, 738
Geometrical theory
  of Platzeck-Gaviola test, 298
  of wire test, 293
Glass plate, 63
Goniometer, 810
Grazing incidence interferometer, 79, 270, 648
Grazing incidence multipass interferometer, 271
Group refractive index, 61
Haidinger interferometer, 1
Hariharan and Sen Interferometer, 192
Hartmann test, 350
  data reduction, 380
  helical pattern screen in, 382
  implementation, 362
  ophthalmic lenses, 379
  pattern for hyperboloidal mirror, 368
  set up, 362
  theory, 362
  transverse aberrations, 363
  with four holes screen, 376
  with radial pattern screen, 380
  with rectangular screen, 366
Hartmann-Shack test, 383
  concave and convex surfaces test, 389
  convergent lenses, 388
  crossed cylindrical test, 386
Heteroscopic imaging, 689
Hindle test, 445
Holograms, 474
Holographic compensator, 475
Holographic test, 783
Holographic interferometry
  digital, 791
  nondestructive testing, 784
  static, 784
  phase measurement, 783
  time average, 787
Holographic radial shear interferometer, 201
Holography: electrooptic, 795
Holography: two angle, 778
Homogeneity testing, 27
Hyperboloidal surface
  definition, 835
  Foucault test for, 278, 294
  Hartmann test for, 362
  Platzeck-Gaviola test for, 298
  testing, 445, 447, 451
Inhomogeneity testing, 27
Integrating bucket, phase shifting, 561
Interferometers, 83, 638
  lateral shear, 168
  Twyman-Green, 82, 553
  Armitage and Lohmann, 209
  Brown, 192
  Burch, 98
  commercial, 647
  common path, 97
  compensation, 50
  configurations, 3, 82, 168, 650
  coupled, 244, 245
  cyclic, 140
  distance measuring, 649
  double-pass, 259
Interferometers (Continued)

double-pass Fizeau, 263

double-pass radial shear, 195

double-pass Twyman-Green, 264
diffraction based, 158
double focus, 112
dyson, 112
Fabry-Perot, 219
Fizeau, 1, 17, 229, 553
Fresnel zone plate, 102
fringe stabilization, 77
Gates reversal shear, 214
grazing incidence, 79, 648
Haidinger, 1, 33
Hariharan and Sen, 192
holographic radial shear, 201
Jamin, 137, 215
Koster reversal shear, 213
lateral shear, 108, 122
Linnik or Smartt, 116, 302
Mach-Zehnder, 553
Murty, 150, 152
Murty and Hagerott, 209
multiple beam Fizeau, 224, 259
multiple image, 80, 81, 556
multiple-pass, 259, 266
Mach-Zehnder, 77, 142, 146, 167, 553
Michelson, 139, 143
Newton, 1, 3
oblique incidence, 78
open path, 77
plane parallel, 150, 152
point diffraction, 116
polarization based, 162
phase shifting, 102, 547, 550, 740
polarization, 669, 735
radial shear, 185, 187
reversal shear, 185, 211
rotational shear, 185, 204
Saunders prism, 114
Saunders reversal shear, 214
scatter plates, 98
Shack-Fizeau, 34
series, 244, 246
Steel radial shear, 198, 200
Som radial shear, 199
thick lens radial shear, 202
triangular-path, 79, 140
Twyman-Green, 46
unequal-path, 73
wavelength scanning, 724
wavefront-reversing, 115
Williams, 47

Interferogram analysis, 638
zero crossing, 638
synchronous detection, 639
heterodyne interferometry, 640
phase lock interferometry, 641
spatial synchronous, 642
Fourier methods, 642
computer processing for, 644

Interferometric optical profilometers, 668, 695
grazing incidence, 270
multiple wavelength, 667
multiple beam, 219, 221
multiple pass, 266
Murty radial shear, 195, 199
Static holographic, 785
speckle, 791
two wavelength, 668, 702
white light, 667, 669, 711, 731
Irradiance transport equation, 425
Isophots in Airy pattern, 404, 406

Jamin interferometer, 137, 215
Knife-edge test, 275
Köster reversal shear interferometer, 213

Laplacian, 421
Lateral shearing interferometer, 108, 122
Lateral shearing interferometer
directional, 166
fringe patterns, 168
vectorial, 164
Lateral aberrations, 504
Lens testing, 69, 276
Light sources, 9, 11, 23, 36, 123
Light sources, 80, 74, 149, 207, 413, 650, 724
for star test, 413
infrared laser, 80
laser, 74, 149
size in radial shear, 207
wavelength tunable, 724
Linnik interferometer, 116
Lower test, 349
Lyot test, 305
Mach-Zehnder interferometer, 77, 142, 146, 167, 553
Meinel tests, 449
Michelson interferometer, 139, 143
Microdisplays, 773
Microscope
atomic force, 678, 686
differential interference contrast, 736
objectives, 415
scanning probe, 674
scanning tunneling, 676
testing, 71, 439
Moiré, 756
analysis of interferogram, 482
patterns of interferograms, 762
patterns of aberrations, 766
projection, 756
Multiple beam interferometer, 24, 221
fringe interval, 235
holographic, 247
with curved surfaces, 243
Multiple beam interferometer: Fizeau, 224, 268
Multiple image interferometer, 80, 81, 566
Multiple wavelength interferometry, 667, 678, 679
Multiple-pass interferometers, 259, 266
Murty and Hagerott interferometer, 209
Murty interferometer, 150, 152
Murty radial shear interferometer, 195, 199
Newton rings, 2, 3, 5
Newton fringes, 2, 3, 5, 10
Newton interferometer, 1, 3
Nodal slide lens bench, 416, 823
Non-null tests, 420, 439
Nondestructive testing, 784
Null Ronchi rulings, 328
Null test configurations, 442
Null test compensator, 454
Oblate spheroid: definition, 835
Oblate spheroid: testing, 472
Oblique incidence interferometer, 78, 82
Off-axis conicoids, 849
Off-axis paraboloids, 850
Offner compensator, 462
Offner reflection compensator, 468
Opaque surfaces, 17
Open path interferometer, 77
Optical flats, 4, 7, 10, 12
Optical focus sensor, 668, 687
Optical materials, 12
Optical profilometers, 668, 685
Optical ranging, 669, 741
Optical surfaces: plane, 4, 7, 10, 12
Optical surfaces
aspherical, 15, 102
spherical, 13, 14, 30, 32
Orthonormal coefficients, 535
Orthonormal polynomials, 537
Paraboloidal surface
definition, 832, 835
Foucault test for, 278, 294
Hartmann test for, 362
off-axis paraboloids, 850
Platzeck-Gaviola test for, 298
testing, 443, 444
Parallel plates, 26, 28, 35
Phase conjugating interferometer, 81, 82
Phase grating Ronchi test, 342
Phase modulation test, 302
Phase shifting, 547, 550
generic, 738
interferometer, 102, 740
methods to produce, 552
point diffraction interferometer, 117
quality functions for, 617
Ronchi test, 348
spatial, 560
temporal, 560
two wavelength, 635
Phase shifting algorithms, 557, 568, 582
2\(1\) averaging, 576
Carré, 574
characteristic polynomial, 589
four steps, 558
Fourier description, 586
Hariharan, 577
least squares, 571
N+1 bucket, 583
N+3 bucket, 584
methods to evaluate, 586
summary of, 591
three steps, 569
Phase shifting error, 599, 600  

detector non-linearities, 602  

source stability, 605  

quantization errors, 606  

vibration errors, 607  

air turbulence, 610  

extraneous fringes, 610  


calibration, 596  

optical, 611  

Phase unwrapping, 623  

in one dimension, 623  

in two dimensions, 625  

temporal, 629  

Phase value photogrammetry, 780  

Phasogrammetry, 780  

Physical theory of Foucault test, 289  

Physical theory of wire test, 293  

Plane parallel interferometer, 150, 152  

Platzeck-Gaviola test, 298  

Point diffraction interferometer, 116, 302  

Polarization interferometers, 735  

Polarization based interferometer, 162, 669  

Polarization phase shifter, 557  

Polynomials, orthonormal, 537  

Porro prism, 67  

Primary aberrations, 83, 128, 166, 320, 501  

Prism, 64, 39, 812  

cube corner, 28  

Saunders, 114  

Porro, 67  

right angle, 816  

testing right angle, 816  

Wollaston, 106  

Profilers, 667  

Profilers. stylus, 670, 683  

Profilometers  

contact, 668, 670  

interferometric, 668, 695  

optical, 668, 685  

stylus, 668  

Projection moiré, 777  

Protactors, 808  

Pyramidal error in prisms, 813  

Radial shear interferometer, 185, 187  

cyclic, 194  

laser, 197  

Radial pattern screen for Hartmann test, 366  

Radius of curvature measurement, 154, 817  

Rayleigh criterion, 61  

Reflecting compensators, 466  

Refractive compensator, 461  

Reversal shear interferometer, 185, 211  

Reversing wavefront interferometers, 115  

Right angle prism, 34  

Rimmer and Wyant method, 135  

Ritchey test, 447  

Ritchey-Common test, 310  

Ronchi test, 317  

circular grid, 347  

null rulings, 328  

patterns, 320  

phase grating, 342, 348  

physical theory, 337, 343, 344  

sideband, 348  

Talbot effect in, 341  

Ronchi-Hartmann test, 350  

Ross compensator, 456  

Rotational laser interferometer, 185, 204  

Saunders reversal shear interferometer, 214  

Saunders method, 134  

Saunders prism interferometer, 114  

Savart polariscope, 104, 108  

Scanning probe microscope, 668, 674  

Scanning tunneling microscopes, 676  

Scatter plates interferometer, 98  

Schwarzschild aberration function, 504  

Secondary aberration function, 504  

Seidel aberrations, 501  

Seidel sums, 503  

Separation of aberrations, 259  

Shack-Fizeau interferometer, 34  

Shadow moiré, 773  

Shafer compensator, 464  

Shearography, 801  

Sideband Ronchi test, 348  

Signal analysis, 728  

Silvertooth test, 447  

Smartt interferometer, 302  

Som radial shear interferometer, 199  

Source size in rotational shear interferometers, 211  

Spatial coherence requirements, 56  

Spatial phase shifting, 564  

INDEX
Speckle
correlation fringes, 793
interferometry, 791
test, 783
Spherical aberration: and Foucault test, 283
Spherical aberration, 411, 417
Spherical surfaces, 13, 30, 32
absolute testing, 72, 651
definition, 832
Foucault test for, 276
Gardner-Bennett test for, 394
Michelson test for, 393
wire test for, 293
Sphero-cylindrical surface, 844
Spheroid, definition, 833
Spheroid: concave surface testing, 833
Spherometers, 817
Abbe:, 819
Aldis, 817
bar, 820
dial, 820
ring, 819
Steinheil, 819
three leg, 818
precision, 819
optical, 821
Square array screen, in Hartmann test, 376
Star test
aspherical aberrations with, 419
astigmatism with, 419
aberrations field, 406
coma with, 419
distortion measurement with, 420
Star test, 398
light source for, 413
optical arrangement, 413
visual, 410
Static holographic interferometry, 785
Steel radial shear interferometer, 198, 200
Structured light projection, 780
Stylus profilometers, 667, 668, 670, 683
Surface microtopography, 232, 234
Surfaces: aspherical, 327
Synthetic wavelength, 759
Synthetic holograms, 477
Talbot effect in Ronchi test, 341
Telescope objective: testing, 442
Templates, 817
Temporal coherence requirement, 60, 74
Test plates, 14, 817
holographic, 476
Test, Speckle, 783
Test, Holographic, 783
Testing
aspherical surfaces, 444, 452, 491, 631
autocollimation, 443
cylindrical surfaces, 453, 844
flat surfaces, 4, 19, 40, 442
hyperboloidal surfaces, 445, 447, 451
oblate spheroid, 472
spherical surfaces, 72, 276, 393, 293, 651
telescope objectives, 442
with computer generated hologram, 478,
483, 485
paraboloidal surfaces, 443, 444
Thick lens radial shear interferometer,
202
Thickness measurement: film and plate, 729,
735
Thin-film thickness measurements, 236
Time-average holographic interferometry,
787
Tolansky inequality, 228, 245
Tolansky fringes, 241
Toroidal surfaces, 842, 843
Transverse aberrations: and wavefront
deformations, 363
Traveling microscope, 821
Triangular path interferometer, 79, 140
TV Holography, 791, 794
Two-angle holography, 778
Two-wavelength interferometry, 668, 703
Two-wavelength testing, 488
Twyman-Green, 553
aberrations compensation, 72
coherence requirements, 46
interferometer, 46, 62
interferograms, 82
phase conjugating, 81
unequal-path, 73
lens testing, 69
microscope objectives, 71
Unequal-path interferometer, 73, 74
Vectorial lateral shearing interferometer, 164
Vertex power, 824
Wave aberration, 501
Wavefront, 126, 83, 91
deformations and transverse aberrations, 363
determination with Fourier transforms, 422
fitting, 498
Wavefront retrieval, 134
with Southwell algorithm, 373
with trapezoidal integration, 370
with polynomial fitting, 368
with radial Shear, 189
with curvature measurements, 421
with two defocused images, 426, 430
with Ronchi Test, 331, 333, 335
with a defocused image, 429
Wavefront: tilt and defocus removal, 368
Wavefront: imaging at the pupil, 441, 442
Wavefront: stitching, 491
Wavefront-reversing interferometer, 115
Wavelength, synthetic, 759

Wavelength, equivalent, 759
Wavelength scanning interferometer, 724
Wedge measurement, 26, 28, 35
White light interferometry, 667, 669, 711, 731
Williams interferometer, 47
Wire test, 293, 275
geometrical theory, 297
physical theory, 299
Wollaston prism, 106, 111
Wolter test, 307

Zernike coefficients, 511, 538
Zernike test, 118, 302
Zernike polynomials, 498
annular, 525
circle, 505, 508
orthonormal, 506
primary aberrations, 521
Zonal screen, 293
Zone plate, 764