

Index

- analytic signal, 44
- angular-momentum operator, 99
- angular spectrum, 143
- angular spectrum and radiation pattern, 127
- angular-spectrum expansion of the multipole fields, 161
- angular-spectrum expansion: diffraction, 311
- angular-spectrum expansion: EM fields, 468, 490
- angular-spectrum expansion: forward and back propagation, 129
- angular-spectrum expansion: generalized, 400
- angular-spectrum expansion: in two space dimensions, 139
- back propagation and the adjoint operator, 193
- back propagation and time reversal, 210
- back propagation: filtered, 206
- back propagation: imaging, 201
- back propagation: in terms of the multipole expansion, 155
- back propagation: inhomogeneous background, 425
- back propagation: inverse diffraction, 314
- back propagation: inverse scattering problem, 425
- Bessel functions, 112
- Bessel functions: spherical, 100
- Bojarski transform, 300
- Bojarski transform: generalized, 304
- Born and Rytov approximations: comparison, 378
- Born approximation: comparison with DWBA, 417
- Born approximation: distorted wave, 415
- Born approximation: EM fields, 491
- Born inversion: limited data, 344
- boundary-value problem: Rayleigh–Sommerfeld, 72, 143
- boundary-value problems: EM fields, 476
- boundary-value problems: exterior, 105, 108, 114
- boundary-value problems: Helmholtz equation, 65
- boundary-value problems: interior, 19, 109
- boundary-value problems: two space dimensions, 76
- boundary-value problems: uniqueness, 70
- Cauchy data, 2, 20
- circularly symmetric objects, 366
- circularly symmetric scatterers, 342
- cloaking: active, 39
- computed tomography, 362, 366
- conjugate-wave radiation condition, 48
- CT projection, 362
- Debye representation, 479
- diffraction, 285
- diffraction: angular-spectrum expansion, 311
- diffraction: Fraunhofer approximation, 313
- diffraction: Fresnel approximation, 311
- diffraction: from apertures, 309
- diffraction: inverse, 314
- diffraction theory: Kirchhoff approximation, 306
- diffraction theory: Rayleigh–Sommerfeld formulation, 308
- diffraction tomography, 367
- diffraction tomography: circularly symmetric objects, 375
- diffraction tomography: hybrid formulation, 367
- diffraction tomography: ideal data, 378
- diffraction tomography: in three space dimensions, 381
- diffraction tomography: in two space dimensions, 368, 370
- Dirichlet-to-Neumann map, 84, 132, 156
- dispersive media, 45
- distorted-wave Born approximation, 417
- essentially non-radiating sources, 33, 63, 208
- essentially non-scattering potentials, 270
- Ewald limiting sphere, 256
- Ewald sphere, 23, 56, 256
- far field, 23
- field back propagation, 59, 78, 79, 336, 431
- field back propagation and radiation pattern, 133
- field back propagation and the Fresnel transform, 150
- field back propagation and the interior boundary-value problem, 157
- field back propagation and the inverse boundary-value problem, 133
- field back propagation and time reversal, 136, 176
- field back propagation: EM fields, 470
- field back propagation: from the EM radiation pattern, 485
- field back propagation: from the radiation pattern, 158
- filtered back-projection algorithm, 364

- filtered back propagation, 201
 filtered back-propagation algorithm, 336, 339, 373
 filtered back-propagation algorithm: EM fields, 493
 filtered back-propagation algorithm: in two space dimensions, 342
 forward and back propagation: EM fields, 472
 forward and back propagation: in two space dimensions, 142
 forward propagation: in terms of the multipole expansion, 155
 Fourier integral, 2, 50
 free field, 127
 free-field propagator, 21, 59, 122, 174
 Fresnel approximation, 147
 Fresnel approximation in two space dimensions, 151
 Fresnel transform, 147

 Green function: conjugate wave, 120
 Green function: Dirichlet and Neumann, 108
 Green function: dyadic Green function, 464
 Green function: frequency domain, 9, 50
 Green function: Helmholtz equation, 50
 Green function: in two space dimensions, 52, 114
 Green function: incoming and outgoing wave, 9
 Green function: incoming wave, 121
 Green function: inhomogeneous medium, 388
 Green function: Lippmann–Schwinger equation, 233
 Green function: multipole expansion, 114
 Green function: plane-wave expansion, 118
 Green function: reciprocity, 389
 Green function: retarded and advanced, 7
 Green function: symmetry, 71
 Green function: time domain, 53, 54
 Green function: wave equation, 6

 Hankel functions, 112
 Hankel functions: spherical, 100
 Helmholtz equation, 9, 45, 333
 Helmholtz equation: homogeneous, 99
 Helmholtz equation: in one space dimension, 51
 Helmholtz equation: in two space dimensions, 113
 Helmholtz equation: inhomogeneous, 387
 Helmholtz equation: potential scattering, 231
 Helmholtz equation: vector, 102, 489
 Helmholtz identities, 77
 Helmholtz theorem, 461
 Hilbert space, 188
 Hilbert space: adjoint operator, 191
 Hilbert space: inverse scattering, 349
 Hilbert space: SVD, 194
 homogeneous isotropic medium, 460

 incoming-wave radiation condition, 10, 48
 initial-value problem, 20
 initial-value problem: plane-wave solution, 91
 integral equation: Porter–Bojarski, 174
 inverse boundary-value problem, 79

 inverse diffraction: back propagation, 314
 inverse diffraction: Slepian–Pollak theory, 319
 inverse diffraction: SVD, 316
 inverse scattering and back propagation, 321
 inverse scattering and the ISP, 336, 350
 inverse scattering and time reversal, 456
 inverse scattering identity, 340
 inverse scattering theory, 333
 inverse scattering: antenna systems, 429
 inverse scattering: arbitrary measurement surfaces, 354
 inverse scattering: Born approximation, 336
 inverse scattering: constraints, 359
 inverse scattering: distorted-wave Born approximation, 423
 inverse scattering: EM fields, 493
 inverse scattering: far-field data, 336
 inverse scattering: far-field formulation, 424
 inverse scattering: for surfaces, 320, 325
 inverse scattering: for surfaces within the PO approximation, 323
 inverse scattering: inhomogeneous background, 423, 426
 inverse scattering: iterative algorithms, 357
 inverse scattering: limited data, 358, 426, 430
 inverse scattering: linearized formulation, 334
 inverse scattering: multistatic data matrix, 429
 inverse scattering: physical-optics approximation, 305
 inverse scattering: pseudo-inverse, 353
 inverse scattering: Rytov approximation, 361
 inverse scattering: short-wavelength limit, 361
 inverse scattering: SIRT algorithm, 359
 inverse scattering: SVD solution, 353
 inverse scattering: tomographic formulation, 360
 inverse source problem, 169
 inverse source problem and boundary-value data, 171, 177
 inverse source problem and Cauchy data, 173
 inverse source problem and surface sources, 179, 186
 inverse source problem and time reversal, 187, 210
 inverse source problem: antenna synthesis, 202
 inverse source problem: EM fields, 479, 485
 inverse source problem: far field, 206
 inverse source problem: for wave equation, 169
 inverse source problem: in one space dimension, 192
 inverse source problem: in two space dimensions, 214
 inverse source problem: inhomogeneous background, 408
 inverse source problem: integral equation, 171
 inverse source problem: limited data, 222
 inverse source problem: Picard condition, 211
 inverse source problem: pseudo-inverse, 198
 inverse source problem: scalar wavelet field, 220
 inverse source problem: sources in slabs, 183
 inverse source problem: SVD, 215

- inverse source problem: time-domain integral equation, 169
- ISP integral equation, 180
- Kirchhoff–Helmholtz representation: EM fields, 467
- Kirchhoff–Helmholtz representation: frequency domain, 58
- Kirchhoff–Helmholtz representation: inhomogeneous background, 394
- Kirchhoff–Helmholtz representation: time domain, 16
- Legendre polynomials, 101
- Liouville–Neumann expansion, 288
- Lippmann–Schwinger equation, 232
- Lippmann–Schwinger equation: EM fields, 489
- Lippmann–Schwinger equation: formal solution, 234
- Maxwell equations, 459, 460
- Maxwell equations: spatial frequency domain, 461
- multipole expansion, 236
- multipole expansion of Dirichlet and Neumann Green functions, 107
- multipole expansion of outgoing-wave Green function, 104
- multipole expansion of the radiated field, 153
- multipole expansion: EM fields, 479, 482
- multipole expansion: in two space dimensions, 251
- multipole expansion: scalar wave, 104
- multipole expansion: scattered field, 249
- multipole expansions and angular-spectrum expansions, 161
- multipole expansions: in two space dimensions, 160
- multipole fields: evanescent-wave components, 110
- multipole fields: plane-wave expansions, 110
- Neumann functions, 112
- Neumann functions: spherical, 100
- non-radiating sources, 29, 63
- non-radiating sources: inhomogeneous background, 402
- non-radiating sources: time domain, 27
- non-scattering potentials, 265, 347
- non-scattering potentials: Born approximation, 266, 269, 348
- operator: angular momentum, 99
- operator: null space, 197
- operator: range, 197
- phase problem, 225, 278, 335
- phase-unwrapping problem, 363, 368
- Picard condition, 197, 211, 410
- plane wave: multipole expansion, 103
- plane-wave expansion: generalized, 397
- plane-wave expansions, 92
- plane-wave expansions: angle-variable form, 97
- plane-wave expansions: homogeneous, 90
- plane-wave expansions: time domain, 90
- plane waves in dispersive media, 92
- plane waves: evanescent, 93, 94
- plane waves: in dispersive media, 94
- plane waves: inhomogeneous, 92, 93
- point-spread function for the ISP, 209, 218
- polar coordinates, 113
- Porter–Bojarski integral equation, 59, 174, 183
- Porter–Bojarski integral equation: inhomogeneous background, 395
- projection-slice theorem, 364
- projection-slice theorem: generalized, 371
- pseudo-inverse, 407
- radiated field: angular-spectrum expansion, 125
- radiated field: angular-spectrum expansion in inhomogeneous background, 401
- radiated field: EM fields, 473, 482
- radiated field: Green-function solution, 14
- radiated power, 25, 60, 163
- radiation pattern, 23, 129
- radiation pattern and angular spectrum, 127
- radiation pattern: EM fields, 466, 484
- radiation pattern: inhomogeneous background, 396
- radiation problem: EM fields, 464
- radiation problem: frequency domain, 43
- radiation problem: frequency-domain solution, 55
- radiation problem: in two space dimensions, 57, 141
- radiation problem: inhomogeneous background, 393
- radiation problem: solution in an inhomogeneous background, 393
- radiation problem: time domain, 12
- Rytov approximation: short-wavelength limit, 274
- Rytov transformation, 275
- scalar wavelet field, 212
- scalar wavelet: in two space dimensions, 220
- scattered energy: optical theorem, 245
- scattered field: computing, 246
- scattered field: multipole expansion, 249
- scattering: Born approximation, 259
- scattering: Born approximation for a cylinder, 259
- scattering: Born approximation for a sphere, 259
- scattering: concentric cylinders, 239, 416
- scattering: from a cylinder, 238
- scattering: from a non-penetrable cylinder, 293
- scattering: from a non-penetrable sphere, 291
- scattering: from a sphere, 236
- scattering: non-penetrable scatterers, 285, 286
- scattering: penetrable objects, 235
- scattering: physical-optics approximation, 295
- scattering: simple non-penetrable shapes, 289
- scattering amplitude, 240
- scattering amplitude: EM, 492
- scattering amplitude: EM fields, 490
- scattering amplitude: generalized, 247
- scattering amplitude: in 2D, 242

- scattering amplitude: limits on resolution, 271
 scattering amplitude: non-penetrable scatterers, 287, 293, 295
 scattering amplitude: PO approximation, 299
 scattering amplitude: theorems, 244
 scattering potential, 333
 scattering states: plane wave, 390
 scattering states: stationary, 390
 scattering theory, 229, 333
 scattering theory: Born approximation, 335
 scattering theory: Born series, 255
 scattering theory: comparison of Born and Rytov approximations, 276
 scattering theory: EM fields, 488
 scattering theory: Ewald limiting sphere, 336
 scattering theory: Ewald sphere, 336
 scattering theory: Foldy–Lax model, 422
 scattering theory: Helmholtz equation, 231
 scattering theory: hybrid approximation, 278
 scattering theory: inhomogeneous background, 413
 scattering theory: linearized, 334
 scattering theory: Liouville–Neumann expansion, 273
 scattering theory: plane waves, 256
 scattering theory: Riccati equation for the phase, 272
 scattering theory: Rytov approximation, 271, 274
 scattering theory: scattering potential, 230
 scattering theory: slant stacking, 280
 scattering theory: transition operator, 253
 separation of variables, 87
 separation of variables: Cartesian coordinates, 89
 separation of variables: cylindrical coordinates, 111
 separation of variables: spherical coordinates, 99
 Shepp and Logan head phantom, 379
 singular value decomposition, 194, 203, 325, 406
 singular value decomposition: inverse scattering, 351
 singular value decomposition: normal equations, 195
 slant stacking, 357
 Slepian–Pollak theory, 196
 Sommerfeld radiation condition, 9, 47
 spherical harmonics, 101
 spherical harmonics: addition theorem, 102
 spherical harmonics: vector, 102
 Sturm–Liouville problem, 87, 319
 surface sources, 179
 surface sources: frequency domain, 81
 surface sources: non-radiating, 38, 82
 surface sources: time domain, 36
 time reversal and back propagation, 80, 176
 time reversal and conjugate waves, 49
 time reversal: in a dispersive medium, 49
 time-reversal imaging, 434
 time-reversal imaging: computational, 444
 time-reversal imaging: DORT algorithm, 447
 time-reversal imaging: experimental, 435
 time-reversal imaging: filtered DORT, 453
 time-reversal imaging: focusing, 443
 time-reversal imaging: multiple frequencies, 453
 time-reversal imaging: multistatic data matrix, 446
 time-reversal imaging: MUSIC algorithm, 452
 time-reversal imaging: non-resolved scatterers, 443
 time-reversal imaging: SVD, 446
 time-reversal imaging: time-reversal matrix, 440, 443
 time-reversal imaging: well-resolved scatterers, 442, 449
 time-reversal matrix, 440
 transition operator, 253
 transition operator: Lippmann–Schwinger equation, 254
 vector spherical harmonics, 482, 484
 wave equation, 11, 12, 36, 37
 wave equation: homogeneous, 18, 20
 wave equation: inhomogeneous, 1, 16
 wave equation: initial-value problem, 91
 wave equation: one-dimensional, 10, 15
 wave equation: reduced, 9, 45
 wavelet field, 137
 Weyl expansion, 118
 Weyl expansion: angle-variable form, 122
 Whittaker representation, 473