

Index

- absorbing boundaries, 205
- addition rule, 318
- AEC, *see* AGC
- afd_explode*, 382
- afd_reflec*, 386
- afd_shotrec*, 383
- afd_vmodel*, 383
- AGC, 250
 - AEC, 251
- aliasing
 - frequency domain, 119
 - spatial, 172
 - time domain, 146
- amplitude
 - decay, 378
 - relative recovery, 253
 - rms, 292
 - spectrum, 218–219
 - true recovery, 253
- amplitude variation with offset (AVO), 353
- analytic signal, 80
- anelastic attenuation, 353
- apparent depth, 368
- apparent dip, 369
- attenuation, 226
 - amplitude spectral decay, 232
 - average Q , 238
 - constant- Q theory, 227
 - drift, 227
 - frequency dependence of velocity, 227
 - interval Q , 238
 - Q , 227
 - Q matrix, 234
 - qtools, 238
 - synthetic seismograms with, 233
- autocorrelation, 42, 43
 - in deconvolution, 269
 - of random signal, 43
 - spectrum of, 43
- automatic gain control, *see* AGC
- AVO, *see* amplitude variation with offset
- balans*, 224
- band limited, 74
- blocklogs*, 243
- body wave region, 331
- bulk modulus, 191
- butterband*, 157
- Cauchy boundary conditions, 390
- Cauchy integral formula, 84
- centered difference, 419
- clip*, 15
- clipping, 14–15
- CMP, *see* common-midpoint stack
- color map
 - gray level, 18
- comb function, *see* sampling comb
- computation triangle, 210
- constant- Q theory, 183
- constphase*, 262
- constphase2*, 262
- convu*, 224
- convmtx*, 132
- convolution
 - 1D, 53
 - 2D, 370
 - averaging width, 134
 - continuous function, 53
 - definition of, 52
 - discrete, 107, 121, 122
 - filtering, 52, 53
 - intuitive, 50
 - as matrices, 130
 - nonstationary, 370
 - numerical, 124, 132
 - via polynomials, 125
 - smoothing, 134
 - theorem, 73
- convolutional model, 50, 248
 - Green's function, 246
 - simple, 248
- convz*, 224
- CREWES, 10
- crosscorrelation, 42, 43
 - application, 44
 - definition, 109
 - discrete, 109
 - normalized, 109
 - spectrum of, 43

- and time shifts, 46
- Vibroseis, 9
- csinci*, 398
- dbspec*, 163
- debugger (MATLAB)
 - commands
 - dbcont*, 33
 - dbdown*, 33
 - dbquit*, 33
 - dbstep*, 33
 - dbstop*, 33
 - dbup*, 33
- decibel scale
 - definition, 4
- deconf*, 254, 262
- deconpr*, 279
- deconvolution, 52, 245
 - always imperfect, 259
 - amplitude ambiguity, 268, 272
 - assumptions, 254
 - autocorrelation windowing, 269
 - convolutional model, 248
 - embedded wavelet after, 259
 - frequency domain, 254
 - frequency-domain algorithm, 257
 - fundamental concept, 254
 - Gabor, 298
 - gapped for noise suppression, 284
 - Hilbert transform, 259
 - methods comparison, 273
 - methods, similarity of, 273
 - minimum-phase, 254
 - noise amplification, 264
 - noise suppression after, 264
 - nonstationary, 288
 - perfect example of, 259
 - power spectrum, role of, 257
 - prediction error filtering, 277
 - prediction filtering, 276
 - predictive, 276
 - noise amplification, 283
 - predictive and water-layer multiples, 280
 - predictive gapped, 279
 - predictive related to spiking, 278
 - purpose or goal, 245
 - role of the autocorrelation, 269
 - spectral smoothing, 257
 - stability constant, 273
 - stationary, 254
 - as a test of minimum phase, 286
 - time domain, 266
 - operator design, 271
 - white-reflectivity assumption, 255
- deconvolution imaging condition, 416
- deconw*, 254, 272
- delta function, 58
- DFT, 137
 - and convolution, 145
 - efficient computation by FFT, 139
 - as exact transform, 138
 - frequencies of, 143
 - frequency sample size, 142
 - matrix, 140
 - time-domain aliasing, 147
- diffraction chart, 372
- dipspectra*, 428
- discrete Fourier transform, *see* DFT
- dispersion relation, 392, 420
- Dix equation, 319
- domfreq*, 67
- downward continuation, 376, 400
- drawray*, 335
- drawvint*, 320
- drayvec*, 348
- dynamic range, 10, 13
- edge effects, 205
- eikonal equation, 345
- einvar*, 230
- emergence angle, 323, 329
- envelope
 - Hilbert, 12
 - trace, 12
- ERM, *see* exploding reflector model
- ERM migration equation, 416
- errors
 - assignment statement, 32
 - declaring variables, 33
 - incorrect matrix sizes, 32
 - logical, 33
 - syntax, 32
- Euler's identity, 56
- evanescent region, 101, 331, 392
- event.dip*, 377
- event.diph*, 377
- event.diph2*, 377
- event.hyp*, 377
- event.pwlinh*, 377
- event.spike*, 377
- eventraymig*, 385
- eventraymod*, 388
- exploding reflector model, 374–376, 382, 383, 404, 427
- f-k* analysis, 356, 358
- f-k* transform, 91
 - definition, 92
 - of a hyperbolic event, 95
 - of a linear event, 93
- fakeq*, 243
- fanfilter*, 179
- fat-skinny rule, *see* time-width-bandwidth principle
- Fermat's principle, 327

- FFT, *see* DFT
- fft*, 144
- fftn*, 172
- fftrl*, 144, 224
- filter
 - antialias, 105
 - band-pass, 54, 135, 155
 - Butterworth, 157
 - causality, 52
 - f-k*, 177
 - high-pass, 155
 - hyperbolic time-variant, 304
 - impulse response, 52, 157
 - linearity, 52
 - low-pass, 135, 155
 - minimum phase, 89
 - panels, 159
 - stable, 128
 - stationarity, 52
 - stationary linear filter, 52
 - time-variant, 169
- filtf*, 135, 157
- filtorm*, 157
- filtspec*, 157
- finite-difference methods
 - absorbing boundaries, 205
 - approximation, 417–418
 - edge effects, 205
 - grid dispersion, 205
 - Laplacian, 201
 - migration, 419
 - migration algorithms, 423
 - modeling, 196, 383
 - sampling, 202
 - stability requirement, 202
 - temporal sample rate, 204
- first break time, 12
- fkmg*, 394
- fktran*, 396
- fortclip*, 35
- forward modeling, 351
- Fourier
 - amplitude spectrum, 61
 - extrapolation operator, 400
 - filter
 - causality, 52
 - impulse response, 52
 - linearity, 52
 - stationarity, 52
 - stationary linear filter, 52
 - Hermitian symmetry, 64
 - kernel, 56
 - orthogonality relation, 57
 - phase (wrapped), 65
 - phase spectrum, 61
 - plane wave, 324
- Fourier transform
 - 2D, 91, 324, 389, *see also f-k transform*
 - continuous, 55, 56
 - convolution theorem, 43, 72, 73
 - definition of, 56
 - differentiation theorem, 72, 75
 - discrete, 109
 - forward, 60
 - inverse, 56, 60, 355, 389
 - multidimensional, 90, 171, 324
 - phase shift theorem, 76, 77
 - properties, 66
 - symmetry, 61, 63, 74
- frequency
 - angular, 60
 - cyclical, 60
 - temporal, 356
- Fresnel zone, 359–361
- fromdb*, 12
- function
 - even, 62
 - odd, 62
- Gabor deconvolution, 298
- Gabor multiplier, 169
- Gabor transform, 166
 - factorization, 170
 - inverse, 167
- gain
 - importance of before deconvolution, 252
- gain recovery
 - AEC, 251
 - AGC, 250
 - t-gain, 249
 - true amplitude processing, 253
- gainmute*, 160
- Gauss’s theorem, 409
- geometrical spreading equation, 345
- global variables
 - definition, 20
 - MYPATH, 29
 - NOSIG, 17
 - PICKCOLOR, 24
 - PICKS, 24
- Green’s function model, 247
- Green’s theorem, 409
- grid dispersion, 202, 205
- Heaviside step function, 86
- Helmholtz equation, 411
- Hilbert attributes, 81
- Hilbert space, 109
- Hilbert transform, 79
 - in deconvolution, 259
- Hooke’s law (for fluid), 191
- horizontal slowness, 323, 363
- Huygens’ principle, 371

- hyperbolic
 - diffraction, 378
 - partial differential equation, 186
 - summation, 380
- hyperfilt*, 304
- ifftnl*, 144
- ifktran*, 396
- image displays, 18
- imaging, *see* migration
- imaging condition, 375
- impulse*, 157
- impulse response, 52
- input variables, 30
- instantaneous amplitude, 81
- interpbl*, 117
- interpolation
 - sinc function, 116
- inverse filter, 127
- inverse modeling, 351
- ismin*, 220
- Kirchhoff
 - diffraction integral, 413
 - migration, 409
- klauder*, 8
- Klauder wavelet, 7
 - definition, 9
- lag, 42
- Laplacian, 184, 192, 193, 200
 - fourth order, 200
 - second order, 200
- least squares
 - Wiener filter theory, 268
- Levinson recursion, 218
- levrec*, 219
- line*, 24
- local variables, 20
- makesections*, 381
- makestdsyn*, 381
- makestdsynh*, 381
- MATLAB
 - function, 30
 - function prototype, 31
 - input variable, 30
 - mathematical function, 37
 - script, 28
 - vector addressing, 35
- matrix
 - multiplication, 131
 - trajectory, 33
- maxcorr-eps*, 263
- maxcorr-phi*, 262
- migrated time display, 406
- migration
 - 3D, 360
 - definition of, 351
 - depth migration, 352, 365–367, 407
 - direct migration, 376
 - downward continuation, 376
 - f-k*, 389, 394
 - f-k*, 423–424
 - finite difference, 419, 423
 - Kirchhoff, 409
 - phase shift, 400, 405–408
 - recursive migration, 376
 - time migration, 352, 365–367, 406
 - wavefront migration, 369
- migrator’s equation, 369, 393
- minimum phase
 - computing, 89
 - continuous, 87
 - discrete, 149
 - filter, 89
 - importance of, 129
 - inverse, 219
 - numerical, 154
 - signal, 154
 - theorem on causal inverse
 - continuous, 89
 - discrete, 152
 - theorem on Hilbert transform
 - continuous, 88
 - discrete, 154
 - theorem on log amplitude
 - continuous, 87
 - discrete, 150
 - theorem on zeros, 129
 - theorem on zeros and poles, 129
 - wavelet, 218, 219
- multiples, 210
 - nonstationary, 214
 - surface related, 211
- nargin*, 31
- Newton’s second law, 192
- noise
 - white, 136
- nonstationary, 233
- norm
 - L^1 , 69
 - L^2 , 69
 - L^∞ , 69
- normal-incidence raytrace migration, 363
- normray*, 384
- normraymig*, 384
- Nyquist frequency, 105, 217
- OBC recording, 213
- ormsby*, 8, 215
- Ormsby wavelet, 7, 70, 217, 218

- P-wave, 183, 310, 327
 - convolution model, 50
 - reflection coefficient, 352
- parabolic wave equation, 420
- Parseval's equation, 68
- phase
 - phase shift theorem, 77, 403
 - spectrum, 61
- phase rotation, 78
 - best constant, 263
 - frequency domain, 78
 - time domain, 79
- phsrot*, 221
- picker*, 25
- picking, 24
 - drawing on data, 24
 - first breaks, 25
- plotimage*, 18, 24
 - maximum data scaling, 19
 - mean data scaling, 19
 - picking facility, 24
- plotseis*, 16
- plotseismic*, 18
- prediction error filtering
 - use in deconvolution, 277
- prediction filtering
 - use in deconvolution, 276
- pressure seismogram, 210
- pressure wave, *see* P-wave
- pwlnt*, 320
- Q* attenuation, *see* attenuation
- Q* loss, *see* anelastic attenuation
- Q* matrix, 234, 291
- raised-cosine taper, 162
- randn*, 221
- randomness, 222
- ray code, 340
- ray parameter, 323, 327
- ray tracing
 - homogeneous medium, 327
 - inhomogeneous media, 343
 - normal, 384
 - two-point ray tracing, 334
- rayfan*, 335
- rayfan_a*, 335
- raypath, 332
 - isotropic media, 345
 - normal incidence, 354
 - raypath equation, 345
 - turning point, 332
- raytrace_demo*, 335, 341
- rayvelmod*, 348
- reference velocity, 399
- reflec*, 15, 221
- reflection (angle of), 326
- reflection coefficient, 207
 - of P-waves, 352
- reflectivity, 50, 246, 248
 - 3D, 353
 - autocorrelation of, 222
 - band limited, 352
 - normal incidence, 353
 - random, 221
 - spectral color, 222
 - time-variant model, 170
 - white, 221
 - white assumption in deconvolution, 255
- reflector dip, 363
- refraction (angle of), 326
- resolution, 356
- ricker*, 8, 215
- Ricker wavelet, 7, 79, 217–218
- rnoise*, 136
- Runge–Kutta method, 347
- S-wave, 183, 327
- sample rate, 357
- sampling comb, 110
- sampling effects
 - time domain, 116
- sampling frequency, 111
- sampling theorem, 104, 105, 107, 111, 361
- scattering angle, 372, 424, 426
- scattering event, 211
- scatterpoint, 414
- Schwartz's inequality, 316
- seisclrs*, 18
- seismic data
 - drawing on top of, 24
 - prestack, 355, 359
- seismic processing
 - stretching, 184
- seismic trace, 5
- seismo*, 239
- seismogram(s)
 - convolutional, 221
 - crosscorrelation, 404
 - displacement, 212
 - extrapolated, 376
 - Goupillaud or Waters, 210
 - with multiples, 239
 - nonstationary, 233
- shah function, *see* sampling comb
- Shannon sampling theorem, 104, 107
- shear wave, *see* S-wave
- shootray*, 335
- shootraytosurf*, 350, 388
- shootrayvæz*, 349, 385
- shootrayvæz_g*, 349

- signal, 41
 - causal spectrum, 83
 - continuous-time, 41
 - discrete-time, 104
 - energy, 68
 - minimum-phase, 154
 - multidimensional, 41
 - reconstruction, 105
 - sampling, 104, 105
 - sampling comb, 110
 - sampling theorem, 104, 107
 - stable, 128
 - time-reversed, 67
 - two-sticker, 128
- signal-to-noise ratio, 136, 225, 359
- simplezoom*, 15
- sinc function interpolation, 115, 116
- slicemat*, 34
- slowness (horizontal), 95
- Snell's law, 326–327
- source ghost, 182
- source waveform, 209
- spatial aliasing, 427
- spectral analysis, 160
- spectral color, 222
- spectrum, 61
 - amplitude, 61
 - causal signal, 83
 - energy, 43
 - meaning of $f = 0$, 66
 - phase, 61
- spherical divergence (spreading), 183
- static shift operator, 402
- stationary traveltimes, 327
- Stolt stretch, 399
- stress
 - in relation to strain, 191
- sweep, 9
- sweep*, 215
- synsections*, 377
- synthetic seismograms
 - 1D, 206
 - codes
 - random reflectivity, 221
 - in MATLAB, 215
 - multiple layer, 210
 - multiples, 210
 - primaries only, 208
 - Q matrix, 234
 - random noise, 225
 - source waveform, 209
- Taylor series, 417
- TBP, *see* time-width–bandwidth principle
- time dip, 95, 324
- time–depth conversion, 361
- time–depth curve, 311
- time-stepping simulation, 201
- time-width–bandwidth principle, 70
- tntamp*, 219
- todb*, 12, 145, 224
- Toeplitz matrix, 131
- trace envelope, 81
- trace excursion, 16
- trace models
 - nonstationary, 290
 - stationary, 290
- traceray*, 335
- traceray-pp*, 335
- traceray-ps*, 335
- translation invariance, 52
- transmission coefficient, 207
- transmission loss, 209
- traveltimes, 311
 - curve, 372, 373, 408
 - general expression, 328
- uncertainty principle, 70
- unit causal function, 86
- universal velocity function, 331
- unwrap*, 65
- vave2vint*, 320
- vector programming, 37
- velocity
 - apparent, 93, 323, 326
 - average, 313
 - instantaneous, 310, 361
 - traveltimes, 311
 - interval, 317, 319
 - inversion, 309
 - mean, 314
 - physical, 309
 - real, 323
 - root mean square (rms), 315
 - stacking, 319
 - time dip, 324
 - universal velocity function, 331
 - velocity measures, 309
- vertical traveltimes, 311
- Vibroseis, 7
- vint2t*, 320
- vint2vave*, 320
- vint2vrms*, 320
- volume dilatation, 191
- vrms2vint*, 320
- vspmodelq*, 242
- wave
 - crest, 324
 - direction of propagation, 325
 - displacement, 213
 - of displacement, 211

wave (<i>cont.</i>)	code, 215
in a heterogeneous fluid, 191–193	embedded, 161
incident, 211	Klauder, 7
longitudinal, 186	least-squares inverse, 266
periodic plane wave, 326	minimum phase, 7
pressure, 213	minimum-phase, 218
scattering, 211	normalization, 217
transverse, 186	Ormsby, 7, 70, 217, 218
velocity, 186, 356	Ricker, 7, 217–218
wave equations	temporal length, 217
1D scalar, 186	zero phase, 7
acoustic, 196	wavelike region, 101
eikonal equation, 345	<i>wavemin</i> , 5, 8, 215
Fourier transformed, 100	<i>wavenorm</i> , 217
general solution, 100	wavenumber, 356–357
geometrical spreading, 345	wavenumber vector, 325
hyperbolic partial differential equation, 184	<i>wavevib</i> , 215
parabolic, 420	<i>wavez</i> , 215, 221
for pressure, 192	<i>which</i> , 29
scalar, 184	white reflectivity, 221
variable-velocity scalar, 344	Wiener filter theory
wavefield	design equations, 268
conditions, 206	least squares, 268
direction of travel, 91	normal equations, 268
downward-traveling waves, 100	wiggle trace display, 10
extrapolation, 404–405	window, 162
snapshot, 199	WTVA, 13–18
time-stepping, 199	<i>wtva</i> , 14
upward-traveling waves, 100	
wavefront propagation, 326–327	
wavelength	z-transform, 126
apparent, 325	and DFT, 126
minimum, 202	zero-offset diffraction hyperbola, 416
wavelet, 50	zero-offset section, 353, 369
amplitude spectrum, 218	Zoeppritz equations, 353
analysis, 206	ZOS, <i>see</i> zero-offset section