

Index

Entries set in *italic* type indicate an example.

- Abort Landing in the Presence of Windshear*, 284
- active set method, 18, 33
- active set strategy, 16
- adjoint equations, 124
- adjoint or costate variables, 123
- Algebraic Function Approximation*, 240
- Alp Rider*, 163
- Analytic ODE Solution, Analytic Derivative*, 112
- Andrew's Squeezer Mechanism*, 310
- augmented Lagrangian function, 22
- autonomous system, 93, 123
- B-Spline Approximation*, 236
- backward Euler method, 100
- Bang-Bang Control*, 216
- barrier function, 33
- barrier method, 31
- barrier parameter, 33, 77
- bilevel optimization problem, 36
- Bolza, problem of, 131
- boundary conditions, 92
- boundary value problem (BVP), 92
- Brachistochrone*, 215
- Broyden update, 11
- Broyden–Fletcher–Goldfarb–Shanno (BFGS) update, 11
- Brusselator Problem*, 117
- calculus of variations, 123
- cancellation error, 47
- central path, 34
- collocation, 127
- collocation method, 100
- Compton Gamma Ray Observatory Reentry*, 232
- consistent function generator, 109, 115
- consistent initial conditions, 201, 322
- constraint qualification test, 28
- continuous functions, 131
- control equations, 124
- control variable, 101, 130
- control variable equality constraint, 125
- convergence
 - quadratic, 3
 - superlinear, 5
- curvature, 9
- DAE index, 104
- DAEs are not ODEs*, 105
- Davidon–Fletcher–Powell (DFP)
 - update, 12
- defect, 95, 126
- defective subproblem, 61, 62
- delay differential equation (DDE), 385
- Delta III Launch Vehicle*, 336
- differential-algebraic equation (DAE), 101
- direct method, 127
- directional derivative, 9
- discretize then optimize, 115, 178, 192, 194, 199
- Discretized ODE Solution, Analytic Derivative of Discretization*, 113
- Discretized ODE Solution, Analytic Derivative of Exact Solution*, 114

- Discretized ODE Solution, Finite Difference Derivative of Discretization*, 113
- Dynamic MPEC*, 322
- dynamic system, 91
- Enzyme Kinetics*, 386
- Equality Constrained Minimization*, 14
- Euler–Lagrange equations, 124
- event, 108
- exterior point penalty function, 35
- external differentiation, 116
- filter, 26
- Filter Globalization*, 26
- Finite Horizon Optimal Control*, 394
- forward communication, 413
- forward difference, 110
- forward difference approximation, 46
- Free-Flying Robot*, 326
- function error, 109
- function generator, 109, 413
- Gerschgorin bound, 59, 167
- globalization strategies, 21
- Goddard Rocket Problem*, 213
- grid refinement, 153
- Hamiltonian, 124
- Heat Equation*, 149
- Hermite–Simpson (compressed) (HSC), 99, 133, 142
- Hermite–Simpson (separated) (HSS), 143
- Hessian of the Lagrangian, 13
- holonomic constraints, 316
- Hypersensitive Control*, 170
- Immunology Example*, 389
- index reduction, 104, 125, 200, 215, 312
- index sets, 52
- index-one DAE, 104
- indirect method, 127
- indirect transcription, 178
- Industrial Robot*, 304
- Inequality Minimization—Active Constraint*, 17
- Inequality Minimization—Inactive Constraint*, 17
- inertia, 59
- Infeasible Constraints*, 40
- initial conditions, 92
- initial value problem (IVP), 92
- integration stepsize, 97
- interior-point algorithm, 34
- interior-point method, 31
- internal differentiation, 110, 117
- inverse problems, 219
- iteration matrix, 167
- K-stage Runge–Kutta*, 98, 145
- Karush–Kuhn–Tucker (KKT) system, 15
- Kinematic Chain*, 315
- Kinetic Batch Reactor*, 331
- Lagrange, problem of, 131, 168
- Lagrange multipliers, 13
- Lagrangian, 13
- least distance program (LDP), 63
- Levenberg parameter, 25, 59
- limited memory update, 12, 52
- line search, 23
- linear programming (LP), 19
- Linear Tangent Steering*, 135, 178, 241
- Linear Tangent Steering Estimation*, 241
- linkage conditions, 108
- Lobatto methods, 100
- logarithmic barrier function, 77
- Low-Thrust Orbit Transfer*, 265
- mass matrix, 311
- mathematical program with complementarity conditions (MPCC), 36
- mathematical program with equilibrium constraints (MPEC), 37
- Max-Crossrange Alternate Formulation*, 252
- Maximum Crossrange*, 248
- maximum likelihood, 221
- Mayer, problem of, 131, 169
- mesh refinement, 153
- method of lines, 149, 193
- method of steps, 386
- midpoint rule, 100

- Minimax Heating Formulation*, 253
Minimax Problems, 43
minimax problems, 43
minimum curvature spline, 259
Minimum Time to Climb, 256
multibody system, 305, 310, 315
multifrontal algorithm, 56
Multiphase Approximation, 234
multiple shooting, 95, 108, 278
Multiple Shooting Example, 95
Multiple-Pass Aero-Assisted Orbit Transfer, 372
multistep methods, 97, 102
- Newton Method with Line Search*, 23
Newton's method
 univariate optimization, 5
 univariate root finding, 2
Newton's Method—Root Finding, 3
nonlinear least squares (NLS), 70
nonlinear programming (NLP), 28
Nonunique Solution, 46
normal matrix, 70
Notorious Problem, 228
- ODE Example*, 92
one-step methods, 97
optimal control problem, 91
optimize then discretize, 178, 192, 194
ordinary differential equations (ODEs), 91
- parallel shooting, 97
parameter estimation problem, 220
parameters, 130
path constraints, 124, 130
penalty function methods, 22
phase, 108, 129
point functions, 131
pointwise quasi-Newton updates, 52
Pontryagin maximum principle, 124
projected gradient, 15
projected Hessian, 15
Putting Example, 105
- quadratic penalty function, 22
Quadratic Program, 19
quadratic programming (QP), 18
quadrature functions, 131, 168
quasi-Newton method, *see* secant method, 10–12
- Range Maximization of a Hang Glider*, 282
Rank-Deficient Constraints, 41
Rayleigh Problem with Control Constraints, 182
Rayleigh Problem, Mixed State-Control Constraints, 183
Redundancy (Full-Rank), 41
Redundancy (Rank-Deficient), 42
Reorientation of Rigid Body, 299
residual Hessian, 70
residual Jacobian, 70
residuals, 70
reverse communication, 413
- Schur-complement, 56
secant method, 4–5
semiexplicit DAE, 101
sequential nonlinear programming (SNLP) algorithm, 153
sequential quadratic programming (SQP), 29
sequential unconstrained minimization techniques (SUMT), 33
Shooting Boundary Value Problem, 93
shooting method, 94, 108, 242, 273
singular arc, 125
singular perturbation, 101
Space Station Attitude Control, 293
sparsity template, 140, 146
SQP Method, 30
state equations, 130
state variable, 101, 130
state variable constraint, 125
stiff, 100
symmetric rank-one (SR1) update, 11
- tabular data, 257
Trailing Edge Variable Camber, 396
transcription method, 91, 152
transversality conditions, 124
trapezoidal method, 99, 133, 136
Treating Absolute Values, 43
truncation error, 47

-
- trust region, 23
Tumor Anti-angiogenesis, 348
Two-Burn Collocation, 279
Two-Burn Multiple Shooting, 278
Two-Burn Transfer, 273
two-point BVP, 93, 124
- Two-Strain Tuberculosis Model*, 345
Van der Pol Oscillator with State Constraint, 187
Van der Pol's Equation, 101
variational inequalities, 37