

Contents

Introduction	iii
1 Equations in a Banach space	5
1.1 Successive approximations and linearization	5
1.2 Newton's method (semilocal convergence)	6
1.3 Newton's method (local convergence)	10
1.4 Approximate solution of equations	11
1.5 Newton's method and analytic operators I	15
1.6 Newton's method and analytic operators II	19
1.7 Newton-like methods and analytic operators	25
1.8 Local convergence using data at one point	32
1.9 Convergence without Lipschitz conditions	36
1.10 Local convergence for inexact methods	40
1.11 Inexact Newton-like method	47
1.12 Two-point methods	52
1.13 Two-step Newton-like method and recurrent functions	73
1.14 Exercises	86
2 Convergence under weak assumptions	105
2.1 Newton's method under Vertgeim-type conditions	105
2.2 An iterative method of asymptotic order $1 + \sqrt{2}$	116
2.3 A finer analysis for inexact Newton methods	130
2.4 Multistep simplified Newton-like methods	142
2.5 A comparison between convergence theorems	146
2.6 The radius of convergence of Newton's method	156
2.7 Newton's method under Hölder continuity	160
2.8 The generalized Hölder case	167
2.9 A nonsmooth version of Newton's method	175
2.10 The secant method under the Gamma condition	182
2.11 Newton's method under a weak Gamma condition	191
2.12 Exercises	197
3 Special topics with applications I	247
3.1 Moore's theorems	247
3.2 Miranda theorem	251
3.3 A weaker version of the shadowing Lemma	255
3.4 Exercises	259

4	Special topics with applications II	263
4.1	Curve tracing	263
4.2	The multiparameter algebraic Riccati equation (MARE)	267
4.3	The conditioning of semidefinite programs	270
4.4	The structured PSB update in Hilbert space	277
4.5	A nonlinear singular integral equation with a shift	280
4.6	Complexity analysis of Newton's method	282
4.7	Complexity analysis of interpolatory Newton method	288
4.8	Newton's method in Riemannian manifolds	297
4.9	Exercises	302
5	Variational inequalities I	317
5.1	Local convergence for generalized equations	317
5.2	A fast Dontchev-type iterative method	322
5.3	Nonsmooth generalized equations	326
5.4	A superquadratic method	330
5.5	Exercises	336
6	Variational inequalities II	343
6.1	Generalized equations using Newton's method	343
6.2	Nonlinear implicit quasivariational inequalities	350
6.3	Broyden-like methods	356
6.4	Newton-like method without inverses	364
6.5	On a two-step Newton method	369
6.6	Exercises	375
7	Convergence of Newton-like methods	379
7.1	Semilocal convergence	379
7.2	A generalized iteration	390
7.3	Special cases	394
7.4	Exercises	443
8	Equations on Banach spaces with a convergence structure	453
8.1	Convergence to fixed points	453
8.2	Exercises	460
9	A single-step methods generated by point to point mappings	469
9.1	Local convergence analysis	469
9.2	Convergence with a nondifferentiable term	476
9.3	Convergence of Newton-like methods	477
9.4	Applications	479
9.5	Exercises	481
10	Weaker versions of the mesh independence principle	483
10.1	Case I	483
10.2	Case II	491
10.3	Exercises	499

11 Steffensen–type methods for generalized equations	507
11.1 Two–step Steffensen method (Hölder case I)	507
11.2 Two–step Steffensen method (Hölder case II)	512
11.3 Two–step Steffensen method (nonsmooth case I)	517
11.4 Two–step Steffensen method (nonsmooth case II)	522
11.5 Perturbed generalized equations I	526
11.6 Perturbed generalized equations II	531
11.7 Nonsmooth perturbed generalized equations	536
11.8 Exercises	541
Bibliography	545
Glossary of Symbols	569
Index	571