## **Contents**

Pre	face	•
1	The regularity condition. Newton's method	
	1.1 Preliminary results	
	1.2 Linearization procedure	2
	1.3 Error analysis	_
	Problems	(
2	The Gauss-Newton method	10
	2.1 Motivation	10
	2.2 Convergence rates	12
	Problems	14
3	The gradient method	16
	3.1 The gradient method for regular problems	16
	3.2 Ill-posed case	18
	Problems	20
4	Tikhonov's scheme	23
	4.1 The Tikhonov functional	23
	4.2 Properties of a minimizing sequence	24
	4.3 Other types of convergence	27
	4.4 Equations with noisy data	29
	Problems	30
5	Tikhonov's scheme for linear equations	32
	5.1 The main convergence result	32
	5.2 Elements of spectral theory	34
	5.3 Minimizing sequences for linear equations	35
	5.4 A priori agreement between the regularization parameter and the	
	error for equations with perturbed right-hand sides	37
	-rror ror -damious arm berraroes right amin stees	~ .



Contents

	5.5 The discrepancy principle	40
	5.6 Approximation of a quasi-solution	43
	Problems	43
6	The gradient scheme for linear equations	45
	6.1 The technique of spectral analysis	45
	6.2 A priori stopping rule	48
	6.3 A posteriori stopping rule	49
	Problems	53
7	Convergence rates for the approximation methods in the case	
	of linear irregular equations	54
	7.1 The source-type condition (STC)	54
	7.2 STC for the gradient method	57
	7.3 The saturation phenomena	59
	7.4 Approximations in case of a perturbed STC	61
	7.5 Accuracy of the estimates	62
	Problems	63
8	Equations with a convex discrepancy functional by Tikhonov's	
	method	64
	8.1 Some difficulties associated with Tikhonov's method in case	
	of a convex discrepancy functional	64
	8.2 An illustrative example	65
	Problems	67
9	Iterative regularization principle	69
	9.1 The idea of iterative regularization	69
	9.2 The iteratively regularized gradient method	70
	Problems	74
10	The iteratively regularized Gauss-Newton method	76
	10.1 Convergence analysis	76
	10.2 Further properties of IRGN iterations	79
	10.3 A unified approach to the construction of iterative methods	
	for irregular equations	83
	10.4 The reverse connection control	84
	Problems	88
11	The stable quadient method for innerview aculinear acceptions	00
11	The stable gradient method for irregular nonlinear equations	90
	descent method	90
		90
	11.2 Investigation of a difference inequality	95
	11.3 The case of noisy data	93
	FIGUREUS	~ /

	Contents	хi
12	Relative computational efficiency of iteratively regularized methods .  12.1 Generalized Gauss–Newton methods	98 98
	12.2 A more restrictive source condition	100
	12.3 Comparison to iteratively regularized gradient scheme	101
	Problems	102
13	Numerical investigation of two-dimensional inverse gravimetry	
	problem	103
	13.1 Problem formulation	103
	13.2 The algorithm	104
	13.3 Simulations	105
	Problems	109
14	Iteratively regularized methods for inverse problem in optical	
	tomography	111
	14.1 Statement of the problem	111
	14.2 Simple example	112
	14.3 Forward simulation	114
	14.4 The inverse problem	116
	14.5 Numerical results	119
	Problems	121
15	Feigenbaum's universality equation	123
	15.1 The universal constants	123
	15.2 Ill-posedness	125
	15.3 Numerical algorithm for $2 \le z \le 12$	
	15.4 Regularized method for $z \ge 13$	127
	Problems	128
16	Conclusion	130
Ref	erences	132
Indov		137