

Table of Contents

Notations	X
Introduction	1
Chapter 1. Statements and Use of Inverse Problems in Studying Heat Transfer Processes and Designing Engineering Units	3
1.1 Introduction to the problem	3
1.2 Simulation of Heat Transfer Processes	8
1.3 Inverse Heat Transfer Problems (IHTP)	9
1.4 Practical Applications and the Role of Inverse Problems in Thermal Investigations.	19
1.5 The Contents and Structure of the Book	28
1.6 Summary	32
Chapter 2. Analysis of Statements and Solution Methods for Inverse Heat Transfer Problems	33
2.1 Inverse Problems Formulation and Stability of Their Solution	35
2.2 Existence of Inverse Problem Solutions.	48
2.3 Uniqueness of Solution of Inverse Heat Conduction Problems.	50
2.4 Degree of Instability of a Boundary Inverse Heat Conduction Problem.	54
2.5 Conditionally-Well-Posed Statement of Inverse Problems	57
2.6 Regularization Principles of Ill-Posed Inverse Problem Solutions	61
2.7 Summary	69
Chapter 3. Analytical Forms of Boundary Inverse Heat Conduction Problems	70
3.1 Determination of Transient Boundary Conditions in a One-dimensional Case.	71
3.2 Recovery of Boundary Conditions with a Differential Method of Measurement.	75
3.3 Analytical Forms of Multidimensional Inverse Problems	78
3.4 Statement of a Two-Dimensional Inverse Problem	89

3.5	Fictitious Boundary Method for Solving Inverse Boundary Problems	91
3.6	Summary	95
Chapter 4. Direct Algebraic Method of Determining Transient Heat Loads		96
4.1	The Recurrent Algorithm Construction.	97
4.2	The Boundary Condition Recoverability.	101
4.3	Step Regularization Principle and Limits of Method Applicability	103
4.4	The Solution of an Inverse Heat Conduction Problem Using Some Other Methods of Approximation and with Disturbed Data	117
4.5	Algorithmic Presentation of a Two-Dimensional Inverse Heat Conduction Problem	119
4.6	Summary	123
Chapter 5. Solution of Boundary Inverse Heat Conduction Problems by Direct Numerical Methods		124
5.1	Construction of Difference Algorithms	125
5.2	Stability Criterion of the Difference Method for Solving a Boundary Inverse Problem	133
5.3	Investigation into the Stability of Numerical Solution for Inverse Problems	134
5.4	An Implicit Scheme for Inverse Problem Numerical Solution	143
5.5	Artificial Hyperbolization of the Heat Conduction Equation in Solving a Boundary Inverse Problem,	147
5.6	Summary	149
Chapter 6. The Extremal Formulations and Methods of Solving Inverse Heat Conduction Problems		150
6.1	A Boundary Inverse Problem in the Extremal Statement	151
6.2	The Iterative Regularization Principle.	153
6.3	Parametric Optimization in Solving Inverse Problems	155
6.4	Gradient Methods of Parametric Optimization.	158
6.5	Functional Optimization in Inverse Problems.	161
6.6	The Selection of Approximate Solution and the General Appraisal of Gradient Methods	166
6.7	Iterative Algorithms for Solving a Linear Inverse Problem.	169
6.8	Experimental Investigation of Algorithms	172
6.9	Numerical Determination of Heat Loads Under Varying Thermophysical Properties of the Body	179
6.10	Solution of a Non-Linear Inverse Problem in Statement II	184
6.11	The Iteration Technique of Determining Non-Stationary Heat Loads in the Two-Dimensional Case	187
6.12	Summary	190

Chapter 7. Regularization of Variational Forms of Inverse Heat Conduction Problems.	192
7.1 The Regularized Form of Inverse Problems	193
7.2 The Construction of a Regularizing Operator.	196
7.3 Regularization of the Inverse Problem Finite-dimensional Form	200
7.4 The Admissible Degree of Smoothing and Approximation Sampling Procedures.	203
7.5 The Reconstruction Accuracy Analysis of Boundary Heat Conditions.	208
7.6 By-Interval Regularization of a Nonlinear Inverse Problem	215
7.7 Regularized Continuation of the Solution of a Nonlinear Heat Conduction Equation	217
7.8 The Regularization of a Two-Dimensional Inverse Problem	225
7.9 Summary	226
Chapter 8. Iterative Regularization of Inverse Problems	227
8.1 On the Rigorous Basis of the Iterative Regularization	228
8.2 General Formulation and Integral Forms of Linear Inverse Heat Conduction Problems. Gradient of the Residual Functional.	231
8.3 The General Formulation of Nonlinear IHCP. The Problem for an Increment of Temperature Field.	239
8.4 Adjoint Problems and Gradient of a Functional.	245
8.5 Gradient Algorithms with Regard to a Priori Information	262
8.6 Examples of the Construction of the Algorithms for the Solution of Inverse Problems.	281
8.7 Computational Experiments	299
8.8 Summary	327
Conclusion.	329
Bibliography	332
Additional Bibliography	340
Subject Index	345