

Contents

Chapter 1. Uniform schemes

1.1	The class of problems under investigation. The Cauchy problem in Banach space	1
1.2	Uniform schemes	4
1.3	Examples	10
1.4	The method of factorization (sweep)	12
1.5	The method of matrix factorization	13

Chapter 2. Simple schemes in fractional steps for the integration of parabolic equations

2.1	The scheme of longitudinal-transverse sweep	17
2.2	The scheme of stabilizing corrections	21
2.3	The splitting scheme for the equation of heat conduction without a mixed derivative (orthogonal system of coordinates)	21
2.4	The splitting scheme for the equation of heat conduction with a mixed derivative (arbitrary system of coordinates)	23
2.5	The scheme of factorization of a difference operator	25
2.6	The scheme of approximate factorization of operators	27
2.7	The predictor-corrector scheme	28
2.8	Some remarks regarding schemes with fractional steps	30
2.9	Boundary conditions in the method of fractional steps for the heat conduction equation	33

Chapter 3. Application of the method of fractional steps to hyperbolic equations

3.1	The simplest schemes for one-dimensional hyperbolic equations	42
3.2	Uniform implicit schemes for equations of hyperbolic type . . .	44
3.3	Implicit schemes for hyperbolic equations in several dimensions	45
3.4	The splitting scheme of running computation	48
3.5	Method of approximate factorization for the wave equation . .	50
3.6	The method of splitting and majorant schemes	50

Chapter 4. Application of the method of fractional steps to boundary value problems for Laplace's and Poisson's equations

4.1	The relation between steady and unsteady problems	54
4.2	The integration schemes of unsteady problems and iterative schemes	56
4.3	Iterative schemes for Laplace's equation in two dimensions . .	59
4.4	Iterative schemes for Laplace's equation in three dimensions .	66
4.5	Iterative schemes for elliptic equations	70
4.6	Schemes with variable steps	73
4.7	Iterative schemes based on integration schemes for hyperbolic equations	76

4.8	Solution of the boundary value problem for Poisson's equation	78
4.9	Iterative schemes with averaging	79
4.10	Reduction of schemes of incomplete approximation to schemes of complete approximation	80
Chapter 5. Boundary value problems in the theory of elasticity		
5.1	The equation of elastic equilibrium and elastic vibrations	82
5.2	Boundary value problems in the theory of elasticity	84
5.3	The integration scheme for the unsteady equations of elasticity	85
5.4	Iterative schemes of solution of boundary value problems for the biharmonic equation	85
5.5	Iterative schemes for the system of equations of elastic displacements	88
5.6	Boundary conditions in problems of elasticity	88
Chapter 6. Schemes of higher accuracy		
6.1	Uniform schemes of higher accuracy	92
6.2	Factorized schemes of higher accuracy for the equation of heat conduction	94
6.3	Solution of Dirichlet's problem with the use of the schemes of higher accuracy	96
Chapter 7. Integro-differential, integral, and algebraic equations		
7.1	Equations of kinetics	99
7.2	Algebraic equations	101
Chapter 8. Some problems of hydrodynamics		
8.1	Potential flow past a contour	102
8.2	Potential flow of an incompressible heavy liquid with a free boundary (spillway problem)	104
8.3	The flow of a viscous liquid	106
8.4	The method of channel flows	110
8.5	The predictor-corrector method (method of correctors)	113
8.6	The equations of meteorology	115
Chapter 9. General definitions		
9.1	General formulation of the method of splitting. Validity of the method as determined by the elimination principle in the commutative case	117
9.2	Validity of the method of splitting in the non-commutative case	120
9.3	The method of approximate factorization of an operator	123
9.4	The method of stabilizing corrections	126
9.5	The method of approximation corrections	128
9.6	The method of establishing the steady state	130
Chapter 10. The method of weak approximation and the construction of the solution of the Cauchy problem in Banach space		
10.1	Examples	132
10.2	A weak approximation for a system of differential equations	136
10.3	Convergence theorems	143
References		151
Subject Index		158