

Table of Contents

Preface	v
1 Adaptive Numerical Solution of MFS Systems	1
1.1 Introduction	1
1.2 Error Bounds	2
1.3 Linear Systems	3
1.4 Choice of Test and Collocation Points	4
1.5 Choice of Trial Space	5
1.6 Harmonic Polynomials	6
1.7 Rescaling Fundamental Solutions	7
1.8 Choice of Source Points	12
1.9 Greedy Adaptive Techniques	13
1.10 Examples	15
2 The Method of Fundamental Solutions for the Laplace Equation with Mixed Boundary Problems	29
2.1 Introduction	29
2.2 Algorithms and Stability	30
2.2.1 Algorithms	30
2.2.2 Stability	34
2.3 Error Estimates	34
2.4 Numerical Experiments	40
2.5 Concluding Remarks	45
3 Reconstruction of Inclusions or Cavities in Potential Problems Using the MFS	51
3.1 Introduction	52
3.2 Direct and Inverse Problem	53
3.2.1 Uniqueness	54

3.3	The MFS and its Connection to Kirsch-Kress Method	56
3.3.1	Multi-connected Domain - Approximation by the MFS	56
3.3.2	Kirsch-Kress Method using MFS	61
3.3.3	Retrieving the Barycenter	63
3.4	Numerical Simulations	64
3.4.1	Iterative MFS Approach to the Inverse Problem	67
3.5	Conclusions	71
4	The Method of Fundamental Solutions for Solving Elliptic Partial Differential Equations with Variable Coefficients	75
4.1	Introduction	76
4.2	Standard Formulation	78
4.2.1	The Method of Particular Solutions	78
4.2.2	The Method of Fundamental Solutions	80
4.2.3	Kansa's Method	82
4.3	Methodology	83
4.4	Numerical Results	87
4.5	Concluding Remarks	99
5	On Efficient MFS Algorithms Using Complex Representations	107
5.1	Introduction	107
5.2	Potential Problems	109
5.3	Elastostatics Problems	112
5.4	Conclusions	119
6	The Method of Fundamental Solutions for Steady-State Non-linear Heat Conduction	127
6.1	Introduction	127
6.2	Mathematical Formulation	128
6.2.1	Kirchhoff's transformation	130
6.3	The method of Fundamental Solutions (MFS)	132
6.4	Numerical Results and Discussion	134
6.5	Conclusions	137
7	A Multi-Level Regularized Version of the Method of Fundamental Solutions	145
7.1	Introduction	145

7.2	The Idea of the Regularized Method of Fundamental Solutions (RMFS)	148
7.3	Error Estimations	150
7.4	Improvement by Off-boundary Sources	154
7.5	Combination with the Direct Multi-Elliptic Interpolation . .	157
7.6	Summary and Conclusions	160
8	The Method of Fundamental Solutions for Solving Axisymmetric Isothermal Gas Flow in Porous Medium	165
8.1	Introduction	166
8.2	Problem Description	167
8.3	Motion Equations	168
8.4	Algorithm for Solving Initial-boundary Problems	171
8.5	The MFS for Solving Boundary Value Problems	173
8.5.1	Numerical implementation	175
8.6	Numerical Results	176
8.7	Conclusions	178
9	The Method of Fundamental Solutions for Low Reynolds Number Flows with Moving Rigid Body	181
9.1	Introduction	182
9.2	Governing Equations	184
9.3	ELMFS Formulations	187
9.4	Numerical Results	189
9.4.1	Lid-driven Cavity Flow	190
9.4.2	Navier-Stokes Problem with a Moving Cylinder	190
9.5	Conclusions	197
10	The Method of Fundamental Solutions for Fully Developed Laminar Flow of Power-Law non-Newtonian Fluid in Ducts of Arbitrary Cross-Section	207
10.1	Introduction	207
10.2	Statement of the Problem	210
10.3	Solution Methodology	213
10.4	The Considered Duct	216
10.4.1	The Circular Duct	216
10.4.2	The Square and Rectangular Duct	217

10.5	Results of Numerical Experiments	219
10.6	Conclusions	224
11	Shear Deformable Plate Analysis by the Method of Fundamental Solution: Static and Dynamic	227
11.1	Introduction	227
11.2	Fundamental Solution for Reissner/Mindlin Plate in Laplace Domain	229
11.3	The MFS in the Laplace Transform Domain	235
11.4	Numerical Examples	238
11.4.1	A Cantilever Plate Subjected to Static Loads Along the Edge	238
11.4.2	Cantilever Plate Subjected to Shear Force Suddenly Applied at the End	241
11.4.3	Simply Supported Plate Subjected to Uniform Load Suddenly Applied in Domain	241
11.5	Conclusions	245
12	Calculation on Stress Concentration of Dull Elliptical Holes by the MFS Using Equally Dispersed Point Loads	247
12.1	Introduction	247
12.2	The Method of Fundamental Solutions	248
12.3	Infinite Plate Including Elliptical Hole with Internal Pressure	250
12.4	Effect of Bias Disposition	251
12.5	Effect of equally dispersed point loads (EDPL)	254
12.6	Conclusions	256
13	Dipole Plate Bending Formulation for the Method of Fundamental Solutions	261
13.1	Introduction	261
13.2	The Traditional Monopole Formulation	262
13.3	The Proposed Dipole Formulation	263
13.4	Dipole Numerical Implementation	269
13.4.1	Obtaining the Source Intensities	270
13.4.2	Calculation of the Solution at Interior Points	271
13.5	Body Forces	271
13.6	Numerical Measures	271
13.7	Numerical Examples	273

13.8	Conclusions	279
14	Performance of the MFS in the Computation of Seismic Motion and Rotation	281
14.1	Introduction	281
14.2	The Method of Fundamental Solutions	283
14.3	Alternative Simplified Approach	287
14.4	Performance of the MFS	288
14.5	Conclusions	296
15	A Modified Method of Fundamental Solutions for Potential Flow Problems	299
15.1	Introduction	300
15.2	Governing Equations	301
15.3	Solution Process	303
15.3.1	Solution of the Potential Flow	303
15.3.2	Classical Method of Fundamental Solutions	305
15.3.3	Modified Method of Fundamental Solutions	306
15.3.4	Calculation of the Normal on the Boundary	307
15.4	Numerical Examples	309
15.5	Conclusions	318
16	MFS Analysis of Microstrip Antennas	323
16.1	Introduction	323
16.2	The Method of Fundamental Solutions	325
16.3	Determination of Input Parameters	328
16.4	Examples and Results	329
16.5	Conclusions	337