

# Contents

## ROTARY-WING AERODYNAMICS

Boundary Integral Formulations of the Scalar and Vector Wave Equations with Arbitrary Moving Boundaries Y. J. Lee and J. Y. Yang . . . . .	1
Time and Frequency Domain Aerodynamics for Flutter of Helicopter Rotors in Hover F. Mastroddi and L. Morino . . . . .	8
Application of a Panel Method to Aeroelastic Stability of Rotors in Hover O. J. Kwon, D. H. Hodges, D. A. Peters and L. N. Sankar . . . . .	15
A General Purpose Fixed-Wing and Rotary-Wing Compressible Aerodynamics Analysis Method K. Tseng . . . . .	22
Turbomachinery Blade Loading Prediction Using the Panel Method S. Chen . . . . .	29
Panel Methods for Multiple-Rotor Aerodynamics . M. H. Williams . . . . .	36
BEM for the Analysis of Unsteady Aerodynamics of Windmill Rotors in the Presence of Yaw G. Arsuffi, G. Guj and L. Morino . . . . .	44

## UNSTEADY AERODYNAMICS

A Vortex Method for Predicting Unsteady Flow and Boundary Layer Development Around an Airfoil K. Kamemoto and T. Suzuki . . . . .	51
A General Approach to Unsteady Flows in Aerodynamics: Classical Results and Perspectives C. M. Casciola, M. R. Lancia and R. Piva . . . . .	58

## VISCOUS/SEPARATED FLOWS

A Unified Approach for Potential and Viscous Flows in Fixed-Wing and Rotary-Wing Aerodynamics L. Morino . . . . .	68
Linkage Between Potential and Viscous Flows J. C. Wu . . . . .	76
Boundary Element Analysis of Viscous Fluid Flow Problems Using the Time Splitting Method K. Kakuda and N. Tosaka . . . . .	87
Advanced Boundary Element Methods for Incompressible Thermoviscous Flow P. K. Banerjee, G. F. Dargush and K. Honkala . . . . .	94
A Coupling of BEM and FEM for the Viscous Flow Problem G. C. Hsiao and J. F. Porter . . . . .	105
Transient Flow Separation at High-Angle-of-Attack G. A. Watts and J. C. Juang . . . . .	112

<b>A Boundary Element Model for the Taylor-Couette Instability</b> G. Graziani and R. Piva . . . . .	119
<b>Boundary Element Methods for the Navier Stokes Equations</b> M. T. Patterson, J. C. Wu and C. M. Wang . . . . .	124
 <b>TRANSONIC/NONLINEAR FLOWS</b>	
<b>Boundary Element-Lagrangian Solution Method for Nonlinear Free Surface Problems</b> N. Tosaka, R. Sugino and H. Kawabata . . . . .	131
<b>Unsteady Three-Dimensional Transonic Flow Computations Using Field Element Method</b> H. Hu and L. Chu . . . . .	140
<b>Generalisation of the Boundary Integral Method to Nonlinear Problems of Compressible Fluid Flow: The No-mesh Alternative - Part I</b> B. Hunt and R. C. Plybon . . . . .	147
<b>Generalization of the Boundary Integral Method to Nonlinear Problems of Compressible Fluid Flow: The No-Mesh Alternative - Part II</b> B. Hunt and R. C. Plybon . . . . .	155
<b>Unsteady Field Element Method with Embedded Euler Domain for Transonic Pitching Airfoil Flows</b> H. Hu and O. A. Kandil . . . . .	161
 <b>ELASTICITY</b>	
<b>Direct vs. Indirect Boundary Element Methods</b> J. L. O'Brien and T. L. Geers . . . . .	169
<b>Determination of the Maximum Thread Stress in Threaded Structures Using the Boundary Element Method</b> A. Wanderlingh . . . . .	179
<b>Absolute p-Refinement of Two-Dimensional Elasticity Problems in the Vicinity of Boundary Solution Singularities</b> T. J. Urekew and J. J. Rencis . . . . .	193
<b>A Boundary Element Algorithm for Plate Bending Problems Based on Cauchy's Integral Formula</b> R. Piltner and R. L. Taylor . . . . .	200
<b>Stepwise Linear Regression Particular Integrals for Uncoupled Thermoelasticity with Boundary Elements</b> A. Gupta, J. Cheng and S. Saigal . . . . .	207
<b>Boundary Element Method for Composite Bodies</b> M. Vable and Y. Zhang . . . . .	214
<b>Integration of 3D Boundary Elements for Static Elasticity</b> C. T. Dyka, A. M. Remondi and H. R. Millwater . . . . .	225
<b>Alternative Methods for Substructures</b> F. Hartmann and P. Schoepp . . . . .	233
<b>BEASY - An Analysis Tool for Design Engineers</b> S. Nageswaran . . . . .	240

**ELASTOPLASTICITY**

<b>Coupling of Finite Element and Boundary Element Super-Element Methods</b> J. L. Wearing and M. A. Sheikh . . . . .	260
<b>A Variational Formulation of the Boundary Integral Equation Method in Elastodynamics</b> G. Maier, M. Diligenti and A. Carini . . . . .	268
<b>Progress in Applications of BEM to Inelastic Analysis of Solids</b> P. K. Banerjee, D. P. Henry and G. F. Dargush . . . . .	276
<b>Bifurcation Analysis of Elastic Shallow Arch by the Boundary-Domain Element Method</b> N. Tosaka, M. Nonaka and S. Miyake . . . . .	286
<b>Inelastic Analysis via Integral Equations: The Symmetric Approach Illustrated with Reference to the Beam on Elastic Foundation</b> G. Novati and T. Burczynski . . . . .	293
<b>On Boundary Element Inelastic Analysis in the Presence of Softening</b> Z. Cen, G. Maier and G. Novati . . . . .	300

**ELASTODYNAMICS**

<b>An Algorithm for Vectorised Computation in Boundary Element Methods</b> S. Kobayashi, N. Nishimura and H. Kamiya . . . . .	310
<b>Overcoming Nonuniqueness in the Direct BIEM for Three-Dimensional Steady-State Exterior Elastodynamic Problems</b> I. R. Gonsalves, D. J. Shippy and F. J. Rizzo . . . . .	317
<b>Efficient Time and Space Integrations of Stokes Fundamental Solutions - Applications to a Direct Time Domain BEM for Elastodynamics</b> D. L. Karabalis . . . . .	324
<b>Analytical Treatment of Free Term for 3-Dimensional Elastodynamic BEM</b> M. Kitahara and K. Nakagawa . . . . .	336

**FRACTURE**

<b>Analysis of 3-D Near-interface Fractures in Bounded, Heterogeneous Domains Using the Surface Integral and Finite Element Hybrid Method</b> W. D. Keat and M. P. Cleary . . . . .	343
<b>Development of Yield Strip Models Using the Surface Integral and Finite Element Hybrid Method</b> B. S. Annigeri . . . . .	353
<b>Time Domain Boundary Element Analysis of Two-Dimensional Crack Problems</b> J. Dominguez and R. Gallego . . . . .	362
<b>Fracture Analysis of Asymmetrical Cracks by the Surface Integral and Finite Element Hybrid Method</b> A. L. Burgarella, B. S. Annigeri and E. H. Jordan . . . . .	369
<b>Regularised BIEs for Miscellaneous Elasticity Problems</b> N. Nishimura and S. Kobayashi . . . . .	377

A B.E. Solution to Some Contact Problems with Adhesion C. Alessandri and A. Tralli . . . . .	384
<b>DESIGN AND OPTIMIZATION</b>	
Calculation of Aerodynamic Sensitivities by Boundary-Integral Methods and Application to Lifting-Surface Theory E. C. Yates, Jr. and R. N. Desmarais . . . . .	391
Aerodynamic Surface Element Modeling for Analysis of Flight Dynamics A. R. Dusto, M. A. Epton and M. F. Fitzpatrick . . . . .	398
A Boundary Element Shape Design Sensitivity Analysis Formulation for Thermal Radiation Problems J. H. Kane and H. Wang . . . . .	405
Design Sensitivity Analysis for Potential Problems by the Derivative Boundary Element Method G. Aksel and S. Mukherjee . . . . .	412
Consistent Sharp Corner Formulations for Boundary Element Analysis and Sensitivity Analysis J. H. Kane and B. L. Keshava Kumar . . . . .	420
A Direct and Indirect Approach to Shape Optimization Using the Boundary Element Method R. L. West and E. Sandgren . . . . .	427
A Variational Approach for the Sensitivity of Stress Constraints Using Boundary Elements S. Saigal and R. Aithal . . . . .	435
<b>MATHEMATICAL ASPECTS</b>	
Some Observations on the Boundary Element Method F. Rizzo . . . . .	442
Higher Order Elements and Element Enhancement by Combined Regular and Hypersingular Boundary Integral Equations T. J. Rudolphi . . . . .	448
Uniform Convergence of Boundary Element Solutions Using the Collocation Methods Y. Iso . . . . .	456
An Algorithm for Computation of Delay Times in Subsonic and Supersonic Rotary Propeller Flow M. I. Freedman . . . . .	463
An Efficient Nonlinear Transformation for the Numerical Computation of the Singular Integrals Appearing in the 2-D Boundary Element Method E. Alarcon, M. Doblare and J. Sans-Serna . . . . .	472
<b>PARALLEL PROCESSING</b>	
Block LU Decomposition on the Connection Machine System J. L. Richardson . . . . .	480
Parallel Implementation on the ICAP/3090 of a Boundary Element Method Formulation for Fractional Operator Modeled Viscoelastodynamic Structures R. D. Ciskowski, V. Sonnad and K. Xie . . . . .	486

## XIV

Helicopter Free-Wake Analysis on a Massively Parallel Computer T. A. Egolf . . . . .	493
The Influence of Massively Parallel Processing in Boundary Element Computations B. L. Keshava Kumar, J. H. Kane, A. V. Srinivasan and R. B. Wilson . . . . .	500

### ACOUSTICS

High Speed Propeller Acoustics and Aerodynamics - A Boundary Element Approach F. Farassat, M. K. Myers and M. H. Dunn . . . . .	508
A Unified Approach for Aerodynamics and Aeroacoustics of Rotors in Compressible Potential Flows M. Gennaretti and L. Morino . . . . .	515
On the Possibility of Singularities in the Acoustic Field of Supersonic Sources When BEM is Applied to a Wave Equation E. De Bernardis and F. Farassat . . . . .	522
Boundary Element Methods in Probabilistic Acoustic Scattering Problems R. P. Daddazio and M. M. Ettouney . . . . .	529
Structural Acoustics Applications of the BEM and the FEM A. F. Seybert, T. W. Wu and W. L. Li . . . . .	536
A B.E. - F.E. Coupled Acoustic Element for Fluid-Structure Interaction Problems C. Rajakumar, A. Ali and S. M. Yunus . . . . .	543

### THERMAL ANALYSIS

Thermal Aspects of Metal Cutting: A Boundary Element Approach A. Chandra and C. Chan . . . . .	555
Summary of Modern Nodal Integral Methods in Fluid Flow and Heat Transfer G. L. Wilson and R. A. Rydin . . . . .	561

### SOIL MECHANICS/WAVE MOTIONS

The Principle of "Limit Absorption" for Water Wave Diffraction S. Alliney . . . . .	569
A Laplace Transform Boundary Element Method for Axisymmetric Diffusion Problems A. H-D. Cheng, Y. Abousleiman and T. Badmus . . . . .	576