Contents

Part I Invited Papers

Discrete Differential Forms, Approximation of Eigenvalue Problems, and Application to the $p$ Version of Edge Finite Elements ........................................ 3 Daniele Boffi


Some Numerical Approaches for Weakly Random Homogenization .................................................................... 29 Claude Le Bris

Goal Oriented, Anisotropic, A Posteriori Error Estimates for the Laplace Equation .......................................................... 47 Frederic Alauzet, Wissam Hassan, and Marco Picasso

Part II Contributed Papers

Energy Stability of the MUSCL Scheme ........................................ 61 Qaisar Abbas, Edwin van der Weide, and Jan Nordström

Numerical Stabilization of the Melt Front for Laser Beam Cutting ................................................................. 69 Torsten Adolph, Willi Schönauer, Markus Niessen, and Wolfgang Schulz

Numerical Optimization of a Bioreactor for the Treatment of Eutrophicated Water .......................................................... 77 Lino J. Alvarez-Vázquez, Francisco J. Fernández, and Aurea Martínez
Finite Element Approximation of a Quasi-3D Model for Estuarial River Flows ......................................................... 87
Mohamed Amara, Agnès Pétrau, and David Trujillo

Convergence of a Mixed Discontinuous Galerkin and Finite Volume Scheme for the 3 Dimensional Vlasov–Poisson–Fokker–Planck System ......................................................... 97
Mohammad Asadzadeh and Piotr Kowalczyk

Infrastructure for the Coupling of Dune Grids ..................107
Peter Bastian, Gerrit Buse, and Oliver Sander

FEM for Flow and Pollution Transport in a Street Canyon ..........115
Petr Bauer, Atsushi Suzuki, and Zbyněk Jaňour

Stabilized Finite Element Methods with Shock-Capturing for Nonlinear Convection–Diffusion-Reaction Models ..................125
Markus Bause

Finite Element Discretization of the Giesekus Model for Polymer Flows .................................................................135
Roland Becker and Daniela Capatina

A dG Method for the Strain-Rate Formulation of the Stokes Problem Related with Nonconforming Finite Element Methods .........145
Roland Becker, Daniela Capatina, and Julie Joie

Numerical Simulation of the Stratified Flow Past a Body ..................155
L. Beneš and J. Fürst

A Flexible Updating Framework for Preconditioners in PDE-Based Image Restoration Algorithms ..........................163
Daniele Bertacini and Fiorella Sgallari

Stabilized Finite Element Method for Compressible–Incompressible Diphasic Flows ........................................171
M. Billaud, G. Gallice, and B. Nkonga

An Immersed Interface Technique for the Numerical Solution of the Heat Equation on a Moving Domain ..................181
François Bouchon and Gunther H. Peichl

Lid-Driven-Cavity Simulations of Oldroyd-B Models Using Free-Energy-Dissipative Schemes .................................191
Sébastien Boyaval
Adaptive Multiresolution Simulation of Waves in Electrocardiology ..........................................................199
Raimund Bürger and Ricardo Ruiz-Baier

On the Numerical Approximation of the Laplace Transform Function from Real Samples and Its Inversion ........................................209
R. Campagna, L. D’Amore, A. Galletti, A. Murli, and M. Rizzardi

A Motion-Aided Ultrasound Image Sequence Segmentation ..........217
D. Casaburi, L. D’Amore, L. Marcellino, and A. Murli

A High Order Finite Volume Numerical Scheme for Shallow Water System: An Efficient Implementation on GPUs .........................227

Spectral Analysis for Radial Basis Function Collocation Matrices .........................................................................................237
R. Cavoretto, A. De Rossi, M. Donatelli, and S. Serra-Capizzano

Finite Element Solution of the Primitive Equations of the Ocean by the Orthogonal Sub-Scales Method .........................245
Tomás Chacón Rebollo, Macarena Gómez Mármol, and Isabel Sánchez Muñoz

Solution of Incompressible Flow Equations by a High-Order Term-by-Term Stabilized Method ..............................................253
Tomás Chacón Rebollo, Macarena Gómez Mármol, and Isabel Sánchez Muñoz

Solving Large Sparse Linear Systems Efficiently on Grid Computers Using an Asynchronous Iterative Method as a Preconditioner .................261
T.P. Collignon and M.B. van Gijzen

Hierarchical High Order Finite Element Approximation Spaces for H(div) and H(curl) ..........................................................269
Denise De Siqueira, Philippe R.B. Devloo, and Sônia M. Gomes

Some Theoretical Results About Stability for IMEX Schemes Applied to Hyperbolic Equations with Stiff Reaction Terms ................277
Rosa Donat, Inmaculada Higueras, and Anna Martinez-Gavara

Stable Perfectly Matched Layers for the Schrödinger Equations ........287
Kenneth Duru and Gunilla Kreiss
Domain Decomposition Schemes for Frictionless Multibody Contact Problems of Elasticity ...................................................297 Ivan I. Dyyak and Ihor I. Prokopyshyn

Analysis and Acceleration of a Fluid-Structure Interaction Coupling Scheme ..............................................................307 Michael R. Dörfel and Bernd Simeon


Space-Time DG Method for Nonstationary Convection–Diffusion Problems ..............................................................325 Miloslav Feistauer, Václav Kučera, Karel Najzar, and Jaroslava Prokopová

High Order Finite Volume Schemes for Numerical Solution of Unsteady Flows ..........................................................335 Petr Furmánek, Jiří Furst, and Karel Kozel

Multigrid Finite Element Method on Semi-Structured Grids for the Poroelasticity Problem ...........................................343 F.J. Gaspar, F.J. Lisbona, and C. Rodrigo

A Posteriori Error Bounds for Discontinuous Galerkin Methods for Quasilinear Parabolic Problems ..............................351 Emmanuil H. Georgoulis and Omar Lakkis

An A Posteriori Analysis of Multiscale Operator Decomposition ..................................................................................359 Victor Ginting


Solving Stochastic Collocation Systems with Algebraic Multigrid ..............................................................................377 Andrew D. Gordon and Catherine E. Powell

Adaptive Two-Step Peer Methods for Incompressible Navier–Stokes Equations .........................................................387 B. Gottermeier and J. Lang
On Hierarchical Error Estimators for Time-Discretized Phase Field Models .................................................................397
Carsten Gräser, Ralf Kornhuber, and Uli Sack

Nonlinear Decomposition Methods in Elastodynamics ..................407
Christian Groß, Rolf Krause, and Mirjam Walloth

An Implementation Framework for Solving High-Dimensional PDEs on Massively Parallel Computers ..................................................417
Magnus Gustafsson and Sverker Holmgren

Benchmarking FE-Methods for the Brinkman Problem ..................425
Antti Hannukainen, Mika Juntunen, and Rolf Stenberg

Finite Element Based Second Moment Analysis for Elliptic Problems in Stochastic Domains .........................................................433
H. Harbrecht

On Robust Parallel Preconditioning for Incompressible Flow Problems .................................................................................443
Timo Heister, Gert Lube, and Gerd Rapin

Hybrid Modeling of Plasmas ............................................................451
Mats Holmström

A Priori Error Estimates for DGFEM Applied to Nonstationary Nonlinear Convection–Diffusion Equation .................................459
J. Hozman and V. Dolejší

Stable Crank–Nicolson Discretisation for Incompressible Miscible Displacement Problems of Low Regularity ..........................469
Max Jensen and Rüdiger Müller

Simulations of 3D/4D Precipitation Processes in a Turbulent Flow Field ...............................................................................479
Volker John and Michael Roland

2D Finite Volume Lagrangian Scheme in Hyperelasticity and Finite Plasticity .................................................................489
Gilles Kluth and Bruno Després

Local Projection Method for Convection-Diffusion-Reaction Problems with Projection Spaces Defined on Overlapping Sets ...............497
Petr Knobloch
Numerical Solution of Volterra Integral Equations with Weak Singularities ...........................................................507
M. Kolk and A. Pedas

Non-Conforming Finite Element Method for the Brinkman Problem .............................................................................515
Juho Könnö and Rolf Stenberg

Error Control for Simulations of a Dissociative Quantum System ...............................................................................523
Katharina Kormann and Anna Nissen

A Comparison of Simplicial and Block Finite Elements .......................533
Sergey Korotov and Tomáš Vejchodský

Five-Dimensional Euclidean Space Cannot be Conformly Partitioned into Acute Simplices .................................................543
Michal Křížek

The Discontinuous Galerkin Method for Convection-Diffusion Problems in Time-Dependent Domains .........................................................551
Václav Kučera, Miloslav Feistauer, and Jaroslava Prokopová

A Spectral Time-Domain Method for Computational Electrodynamics ....................................................................561
James V. Lambers

Numerical Simulation of Fluid–Structure Interaction in Human Phonation: Application ...............................................571
Martin Larsson and Bernhard Müller

Error Estimation and Anisotropic Mesh Refinement for Aerodynamic Flow Simulations ..................................................579
Tobias Leicht and Ralf Hartmann

A MHD Problem on Unbounded Domains: Coupling of FEM and BEM ........................................................................589
Wiebke Lemster and Gert Lube

A Stable and High Order Interface Procedure for Conjugate Heat Transfer Problems .................................................599
Jens Lindström and Jan Nordström
Local Time-Space Mesh Refinement for Finite Difference Simulation of Waves ...............................................................609
Vadim Lisitsa, Galina Reshetova, and Vladimir Tcheverda

Formulation of a Staggered Two-Dimensional Lagrangian Scheme by Means of Cell-Centered Approximate Riemann Solver ............................................................................................................617
R. Loubère, P.-H. Maire, and P. Váchal

Optimal Control for River Pollution Remediation ......................................................627
Aurea Martínez, Lino J. Alvarez-Vázquez, Miguel E. Vázquez-Méndez, and Miguel A. Vilar

An Anisotropic Micro-Sphere Approach Applied to the Modelling of Soft Biological Tissues ......................................................637
A. Menzel, T. Waffenschmidt, and V. Alastrué

Anisotropic Adaptation via a Zienkiewicz–Zhu Error Estimator for 2D Elliptic Problems ..................................................645
S. Micheletti and S. Perotto

On a Sediment Transport Model in Shallow Water Equations with Gravity Effects .................................................................655
T. Morales de Luna, M.J. Castro Díaz, and C. Parés Madroñal

Adaptive SQP Method for Shape Optimization ..................................................663
P. Morin, R.H. Nochetto, M.S. Pauletti, and M. Verani

Convergence of Path-Conservative Numerical Schemes for Hyperbolic Systems of Balance Laws .........................................................675
M.L. Muñoz-Ruiz, C. Parés, and M.J. Castro Díaz

A Two-Level Newton–Krylov–Schwarz Method for the Bidomain Model of Electrocardiology ..................................................683
M. Munteanu, L.F. Pavarino, and S. Scacchi

On a Shallow Water Model for Non-Newtonian Fluids ..................................693
G. Narbona-Reina and D. Bresch

On Stationary Viscous Incompressible Flow Through a Cascade of Profiles with the Modified Boundary Condition on the Outflow and Large Inflow .........................................................703
Tomáš Neustupa
Variational and Heterogeneous Multiscale Methods ...............................713
Jan Martin Nordbotten

Discrete Dislocation Dynamics and Mean Curvature Flow .....................721
Petr Pauš, Michal Beneš, and Jan Kratochvíl

Non-Symmetric Algebraic Multigrid Preconditioners
for the Bidomain Reaction–Diffusion system ........................................729
Micol Pennacchio and Valeria Simoncini

Efficiency of Shock Capturing Schemes for Burgers’ Equation
with Boundary Uncertainty .................................................................737
Per Pettersson, Qaisar Abbas, Gianluca Iaccarino,
and Jan Nordström

FEM Techniques for the LCR Reformulation of Viscoelastic
Flow Problems .......................................................................................747
A. Ouazzi, H. Damanik, J. Hron, and S. Turek

A Posteriori Estimates for Variational Inequalities .................................755
S. Repin

Review on Longest Edge Nested Algorithms ........................................763
Maria-Cecilia Rivara

Simulation of Spray Painting in Automotive Industry ..............................771
Robert Rundqvist, Andreas Mark, Björn Andersson,
Anders Ålund, Fredrik Edelvik, Sebastian Tafuri,
and Johan S Carlson

Numerical Simulation of the Electrohydrodynamic Generation
of Droplets by the Boundary Element Method ......................................781
P. Sarmah, A. Gliëre, and J.-L. Reboud

A General Pricing Technique Based on Theta-Calculus
and Sparse Grids ....................................................................................791
Stefanie Schraufstetter and Janos Benk

A Posteriori Error Estimation in Mixed Finite Element
Methods for Signorini’s Problem ..........................................................801
Andreas Schröder

Solution of an Inverse Problem for a 2-D Turbulent Flow
Around an Airfoil ..................................................................................809
Jan Šimák and Jaroslav Pelant
<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>On Skew-Symmetric Splitting and Entropy Conservation Schemes for the Euler Equations</td>
<td>817</td>
</tr>
<tr>
<td>Björn Sjögreen and H.C. Yee</td>
<td></td>
</tr>
<tr>
<td>Ideal Curved Elements and the Discontinuous Galerkin Method</td>
<td>829</td>
</tr>
<tr>
<td>Veronika Sobotíková</td>
<td></td>
</tr>
<tr>
<td>Analysis of the Parallel Finite Volume Solver for the Anisotropic Allen–Cahn Equation in 3D</td>
<td>839</td>
</tr>
<tr>
<td>Pavel Strachota, Michal Beneš, Marco Grottadaurea, and Jaroslav Tintěra</td>
<td></td>
</tr>
<tr>
<td>Stabilized Finite Element Approximations of Flow Over a Self-Oscillating Airfoil</td>
<td>847</td>
</tr>
<tr>
<td>Petr Sváček and Jaromír Horáček</td>
<td></td>
</tr>
<tr>
<td>Multigrid Methods for Elliptic Optimal Control Problems with Neumann Boundary Control</td>
<td>855</td>
</tr>
<tr>
<td>Stefan Takacs and Walter Zulehner</td>
<td></td>
</tr>
<tr>
<td>Extension of the Complete Flux Scheme to Time-Dependent Conservation Laws</td>
<td>865</td>
</tr>
<tr>
<td>J.H.M. ten Thije Boonkkamp and M.J.H. Anthonissen</td>
<td></td>
</tr>
<tr>
<td>Solution of Navier–Stokes Equations Using FEM with Stabilizing Subgrid</td>
<td>875</td>
</tr>
<tr>
<td>M. Tezer-Sezgin, S. Han Aydın, and A.I. NesliTÜRK</td>
<td></td>
</tr>
<tr>
<td>Multigrid Methods for Control-Constrained Elliptic Optimal Control Problems</td>
<td>883</td>
</tr>
<tr>
<td>Michelle Vallejos and Alfio Borzi</td>
<td></td>
</tr>
<tr>
<td>Modelling the New Soil Improvement Method Biogrout: Extension to 3D</td>
<td>893</td>
</tr>
<tr>
<td>W.K. van Wijngaarden, F.J. Vermolen, G.A.M. van Meurs, and C. Vuik</td>
<td></td>
</tr>
<tr>
<td>Angle Conditions for Discrete Maximum Principles in Higher-Order FEM</td>
<td>901</td>
</tr>
<tr>
<td>Tomáš Vejchodský</td>
<td></td>
</tr>
<tr>
<td>Unsteady High Order Residual Distribution Schemes with Applications to Linearised Euler Equations</td>
<td>911</td>
</tr>
<tr>
<td>N. Villedieu, L. Koloszar, T. Quintino, and H. Deconinck</td>
<td></td>
</tr>
</tbody>
</table>
Implicit–Explicit Backward Difference Formulae
Discontinuous Galerkin Finite Element Methods
for Convection–Diffusion Problems ..............................................921
Miloslav Vlasák and Vít Dolejší

A Cut-Cell Finite-Element Method for a Discontinuous Switch
Model for Wound Closure .............................................................929
S.V. Zemskov, F.J. Vermolen, E. Javierre, and C. Vuik

Index ............................................................................................937
Numerical Mathematics and Advanced Applications 2009
Proceedings of ENUMATH 2009, the 8th European Conference on Numerical Mathematics and Advanced Applications, Uppsala, July 2009
Kreiss, G.; Lötstedt, P.; Målqvist, A.; Neytcheva, M. (Eds.)
2010, XVIII, 850 p. 240 illus., Hardcover
ISBN: 978-3-642-11794-7