



HAL
open science

Preface

Emmanuel Franck, Jürgen Fuhrmann, Victor Michel-Dansac, Laurent Navoret

► **To cite this version:**

Emmanuel Franck, Jürgen Fuhrmann, Victor Michel-Dansac, Laurent Navoret. Preface. Finite Volumes for Complex Applications X-Volume 1, Elliptic and Parabolic Problems, 432, Springer Nature Switzerland, 2023, Springer Proceedings in Mathematics & Statistics, 978-3-031-40863-2. 10.1007/978-3-031-40864-9 . hal-04270231

HAL Id: hal-04270231

<https://hal.science/hal-04270231v1>

Submitted on 6 Nov 2023

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Emmanuel Franck · Jürgen Fuhrmann ·
Victor Michel-Dansac · Laurent Navoret

Editors

**Finite Volumes for Complex
Applications X –
Invited contributions;
Elliptic and parabolic problems**

FVCA10, Strasbourg, France, October 30, 2023 – November 03, 2023

Volume 1

Volume Editors

Emmanuel Franck

Université de Strasbourg, CNRS, Inria, IRMA, Strasbourg, France

E-mail: emmanuel.franck@inria.fr

Jürgen Fuhrmann

Weierstrass Institute for Applied Analysis and Stochastics, Numerical Mathematics and Scientific Computing, Berlin, Deutschland

E-mail: juergen.fuhrmann@wias-berlin.de

Victor Michel-Dansac

Université de Strasbourg, CNRS, Inria, IRMA, Strasbourg, France

E-mail: victor.michel-dansac@inria.fr

Laurent Navoret

Université de Strasbourg, IRMA UMR CNRS 7501, Inria, Strasbourg, France

E-mail: laurent.navoret@math.unistra.fr

Preface

The Finite Volume method is a spatial discretization technique for partial differential equations based on the physical principle of local conservation. It has been successfully used in many applications, including fluid dynamics, magnetohydrodynamics, nuclear physics or plasma physics. Motivated by their large applicability for real-world problems, finite volumes have been the purpose of an intensive research effort in the last decades, yielding significant progress in the design, the numerical analysis, or the practical implementation of the methods.

Research on finite volumes remains very active, as problems are becoming more and more complex. Among the current challenges addressed by the scientific community, let us mention for instance the design of robust (with respect to the mesh and/or physical parameters) numerical methods, of high-order methods, of methods preserving structural properties (positivity or dissipation of a prescribed quantity), or methods enhanced by machine learning approaches.

Previous conferences in this series have been held in Rouen (1996), Duisburg (1999), Porquerolles (2002), Marrakech (2005), Aussois (2008), Prague (2011), and Berlin (2014), Lille (2017) and Bergen (2020, online).

The present volumes contain the invited and contributed papers presented as posters or talks at the 10th International Symposium on Finite Volumes for Complex Applications held at the University of Strasbourg, from October 30 to November 3, 2023.

The first volume contains the invited and contributed papers focusing on finite volume schemes for elliptic and parabolic problems. They include structure-preserving schemes, convergence proofs, and error estimates for problems governed by elliptic and parabolic partial differential equations.

The second volume is focused on finite volume methods for hyperbolic and related problems, such as methods compatible with the low Mach number limit or able to exactly preserve steady solutions, the development and analysis of high order methods, or the discretization of kinetic equations.

The volume editors thank the authors for their high-quality contributions, the members of the scientific committee for supporting the organization of the review process, and all reviewers for their thorough work on the evaluation of each of the contributions.

Finally, we warmly thank the “Cellule Congrès” of the University of Strasbourg, as well as the organizing committee for helping make this conference a great success.

Emmanuel Franck
Jürgen Fuhrmann
Victor Michel-Dansac
Laurent Navoret

Organization

Organizing committee

Joubine Aghili	Université de Strasbourg, IRMA UMR CNRS 7501, Inria, Strasbourg, France
Clémentine Courtès	Université de Strasbourg, IRMA UMR CNRS 7501, Inria, Strasbourg, France
Emmanuel Franck	Université de Strasbourg, CNRS, Inria, IRMA, Strasbourg, France
Jürgen Fuhrmann	Weierstrass Institute for Applied Analysis and Stochastics, Numerical Mathematics and Scientific Computing, Berlin, Deutschland
Philippe Helluy	Université de Strasbourg, IRMA UMR CNRS 7501, Inria, Strasbourg, France
Victor Michel-Dansac	Université de Strasbourg, CNRS, Inria, IRMA, Strasbourg, France
Laurent Navoret	Université de Strasbourg, IRMA UMR CNRS 7501, Inria, Strasbourg, France
Andrea Thomann	Université de Strasbourg, CNRS, Inria, IRMA, Strasbourg, France

Scientific committee

Marianne Bessemoulin-Chatard	LMJL, Université de Nantes, France
Franck Boyer	IMT, Université Toulouse 3 - Paul Sabatier, France
Konstantin Brenner	Université Côte d'Azur, Inria, CNRS, LJAD, Nice, France
Donna Calhoun	Department of Mathematics, Boise State University, USA
Claire Chainais-Hillairet	Université de Lille, France
Pietro Marco Congedo	Inria, Centre de Mathématiques Appliquées, École Polytechnique, IPP, Palaiseau, France
Andreas Dedner	Warwick Mathematics Institute, University of Warwick, United Kingdom
Jerome Droniou	School of Mathematics, Monash University, Melbourne, Australia
Michael Dumbser	University of Trento, Department of Civil, Environmental and Mechanical Engineering, Trento, Italy

Isabelle Faille	IFP Energies nouvelles, Rueil-Malmaison, France
Jiří Fůrst	Czech Technical University in Prague, Faculty of Mechanical Engineering, Department of Technical Mathematics, Prague, Czech Republic
Thierry Gallouët	I2M UMR 7373, Aix-Marseille Université, CNRS, Ecole Centrale de Marseille, Marseille, France
Raphaèle Herbin	3I2M UMR 7373, Aix-Marseille Université, CNRS, Ecole Centrale de Marseille, Marseille, France
Jan S. Hesthaven	Chair of Computational Mathematics and Simulation Science, École Polytechnique Fédérale de Lausanne, Switzerland
Jean-Marc Hérard	EDF R&D, Chatou, France
Volker John	Weierstrass Institute for Applied Analysis and Stochastics (WIAS), Berlin, Germany
Birane Kane	NORCE Norwegian Research Centre AS, Bergen, Norway
Eirik Keilegavlen	Center for Modeling of Coupled Subsurface Dynamics, Department of Mathematics, University of Bergen, Norway
Robert Klöforn	Lund University, Sweden
Konstantin Lipnikov	Applied Mathematics and Plasma Physics Group, Theoretical Division, Los Alamos National Laboratory, Los Alamos, USA
Pierre-Henri Maire	CEA Cesta, Le Barp, France
Sandra May	Uppsala University, Department of Information Technology, Sweden
Gabriella Puppo	Dipartimento di Matematica, La Sapienza Università di Roma, Italy
Jing-Mei Qiu	Department of Mathematics, University of Delaware, Newark, USA
Adrian Florin Radu	Center for Modeling of Coupled Subsurface Dynamics, University of Bergen, Norway

Contents

Invited papers

- A personal discussion on conservation, and how to formulate it 1
Remi Abgrall
- A high order semi-implicit scheme for ideal magnetohydrodynamics 17
Walter Boscheri, Claudius Birke and Christian Klingenberg
- AeroSPEED: a high order acoustic solver for aeroacoustic applications . 33
Alberto Artoni, Paola F. Antonietti, Roberto Corradi, Ilario Mazzieri, Nicola Parolini, Daniele Rocchi, Paolo Schito and Francesco F. Semeraro
- Finite volumes for a generalized Poisson-Nernst-Planck system with cross-diffusion and size exclusion 49
Clément Cancès, Maxime Herda and Annamaria Massimini
- Magic SIAC Toolbox: A Codebase of Effective, Efficient, and Flexible Filters 65
Xulia Docampo Sánchez and Jennifer Ryan
- A Review of Cartesian Grid Active Flux Methods for Hyperbolic Conservation Laws 81
Christiane Helzel and Erik Chudzik
- Moving-Mesh Finite-Volume Methods for Hyperbolic Interface Dynamics . 97
Christian Rohde
- Mixed dimensional modeling with overlapping continua on Cartesian grids for complex applications 113
Malgorzata Peszynska

Contributed papers

- PolyMAC: staggered finite volume methods on general meshes for incompressible Navier-Stokes problems 129
Pierre-Loïc Bacq, Antoine Gerschenfeld and Michael Ndjinga
- Finite Volume Approximations for Non-Linear Parabolic Problems with Stochastic Forcing 137
Caroline Bauzet, Flore Nabet, Kerstin Schmitz and Aleksandra Zimmermann
- A new analysis for a super-convergence result in the divergence norm for Lowest Order Raviart-Thomas Mixed Finite Elements combined with the Crank-Nicolson method applied to one dimensional parabolic equations ... 145
Fayssal Benkhaldoun and Abdallah Bradji

An $L^\infty(H^1)$ -error estimate for Gradient Schemes applied to time fractional diffusion equations	153
<i>Benkhaldoun, Fayssal, Bradji, Abdallah</i>	
Compatible Discrete Operator schemes for solidification and segregation phenomena	161
<i>Jerome Bonelle and Thomas Fonty</i>	
Treftz approximation space for Poisson equation in perforated domains ..	169
<i>Miranda Boutilier, Konstantin Brenner and Victorita Dolean</i>	
Structure Preserving Finite Volume Approximation of Cross-Diffusion Systems Coupled by a Free Interface	177
<i>Clément Cancès, Jean Cauvin-Vila, Claire Chainais-Hillairet and Virginie Ehrlacher</i>	
Finite volume scheme for the diffusive field-road model: study of the long time behaviour	185
<i>Claire Chainais-Hillairet and Matthieu Alfaro</i>	
An approximate two-point Dirichlet flux for quasilinear convection diffusion equations	193
<i>Claire Chainais-Hillairet, Robert Eymard and Jürgen Fuhrmann</i>	
The Two-Point Finite Volume Scheme for the Microscopic Bidomain Model of Electrophysiology	201
<i>Zeina Chehade and Yves Coudière</i>	
Improved Crouzeix-Raviart scheme for the Stokes problem	209
<i>Eric Chénier, Christophe Le Potier, Erell Jamelot and Andrew Peitavy</i>	
Towards a finite volume discretization of the atmospheric surface layer consistent with physical theory	217
<i>Simon Clément, Florian Lemarié and Eric Blayo</i>	
Thermodynamically Consistent discretisation of a Thermo-Hydro-Mechanical model	225
<i>Jérôme Droniou, Mohamed Laaziri and Roland Masson</i>	
Justification of Generalized Interface Conditions for Stokes-Darcy Problems	233
<i>Elissa Eggenweiler, Joscha Nickl and Iryna Rybak</i>	
Two entropic finite volume schemes for a Nernst-Planck-Poisson system with ion volume constraints	241
<i>Jürgen Fuhrmann, Benoît Gaudeul and Christine Keller</i>	
Dimensional reduction by Fourier analysis of a Stokes-Darcy fracture model	249
<i>Martin Gander, Julian Hennicker, Roland Masson and Tommaso Vanzan</i>	
Finite Volumes for Simulation of Large Molecules	257
<i>Martin Heida</i>	

PDE models of virus replication merging 2D manifold and 3D volume effects evaluated at realistic reconstructed cell geometries	265
<i>Markus M. Knodel, Arne Nügel, Eva Herrmann and Gabriel Wittum</i>	
Structure-preserving schemes for drift-diffusion systems on general meshes: DDFV vs HFV	273
<i>Stella Krell and Julien Moatti</i>	
Reduced Basis Approach for convection-diffusion equations with non-linear boundary reaction conditions	281
<i>Sebastian Matera, Daniel Runge and Christian Merdon</i>	
A skeletal high-order structure preserving scheme for advection-diffusion equations	289
<i>Julien Moatti</i>	
Automatic solid reconstruction from 3-D points set for flow simulation via an immersed boundary method	297
<i>Gabriel Narváez, Martin Ferrand, Thomas Fonty and Sofiane Benhamadouche</i>	
Stokes–Brinkman–Darcy Models for Coupled Free-Flow and Porous-Medium Systems	305
<i>Linheng Ruan and Iryna Rybak</i>	
Robust and Efficient Preconditioners for Stokes–Darcy Problems	313
<i>Paula Strohbeck, Cedric Riethmüller, Dominik Göttsche and Iryna Rybak</i>	
A DDFV Scheme for Incompressible Two-Phase Flow Degenerate Problem in Porous Media	321
<i>Crozon Thomas, Saad Mazen and El-Houssaine Quenjel</i>	