Cent. Eur. J. Math. • 10(1) • 2012 • 1-2
DOI: 10.2478/s11533-011-0124-x

VERSITA

Central European Journal of **Mathematics**

Editors' preface for the topical issue "Advances in Numerical Analysis and Numerical Linear Algebra"

Editorial Material

Ljiljana Cvetković[1]*, Sergey Korotov[2,3]†, Victor Nistor[4]‡, Lubin Vulkov[5]§

1 *Department of Mathematics and Informatics, Faculty of Science, University of Novi Sad, 21000 Novi Sad, Serbia*

2 *BCAM – Basque Center for Applied Mathematics, Bizkaia Technology Park, Building 500, 48160 Derio, Basque Country, Spain*

3 *IKERBASQUE, Basque Foundation for Science, 48011 Bilbao, Spain*

4 *Mathematics Department, Pennsylvania State University, University Park, PA 16801, USA*

5 *Faculty of Science and Education, Division of Numerical Analysis and Statistics, Ruse State University, 7017 Ruse, Bulgaria*

MSC: 15-06, 65-06

The current issue of the Central European Journal of Mathematics contains 26 papers devoted to recent advances in Numerical Analysis and Numerical Linear Algebra. Various results of theoretical and computational characters are included in this issue with contributions of renowned and young numerical scientists from Bulgaria, Chile, China, Czech Republic, Denmark, Germany, Greece, Hungary, Iran, Ireland, Israel, Italy, the Netherlands, Norway, Pakistan, Russia, Serbia, Spain, Turkey and the USA. A brief overview of the papers of this issue is given below.

The first block of papers is devoted to one of the most powerful numerical techniques – the finite element method. In the paper by Schweitzer several modern generalizations of the classical finite element method (FEM) are presented and discussed. The focus is on the so called "meshless methods" which have the potential to speed up on of the most time consuming tasks in the applications of FEM in practise: the construction of a good quality mesh. In the work by Vejchodský, the discrete maximum principles for various finite element schemes for elliptic-type equations are reviewed; new results on averaging techniques for FEM are obtained by Dalík; and a new a posteriori error estimation technique based on gradient recovery for FEM approximations for elliptic equations is presented by Horváth and Izsák.

* *E-mail: lila@dmi.uns.ac.rs*
† *E-mail: korotov@bcamath.org*
‡ *E-mail: nistor@math.psu.edu*
§ *E-mail: lvalkov@uni-ruse.bg*

Springer

The second major part of papers is devoted to the usage of another popular numerical techniques – the finite difference method (FDM) and the finite volume method (FVM). The paper by Jovanović and Vulkov deals with a new FEDM scheme for mixed parabolic-hyperbolic transmission problem; O'Riordan uses FDM for a special case of convection-diffusion problems; Gao and Sun apply FDM approach for fractional Klein–Kramers equation in phase space; and Geiser treats spatially-dependent and nonlinear fluid transport problems by FVM.

Another important numerical methods are also addressed in the issue. Thus, the Magnus expansion method used for time-dependent Maxwell equations is discussed by Faragó et al.; the Magnus expansion used for solving non-autonomous evolution equations is analysed in the paper by Bátkai and Sikolya. The Richard extrapolation technique, combined with splitting procedure and θ-method, is applied to initial value problem for ODEs and relevant stability results are obtained in Zlatev et al. Fully discrete spectral scheme for solving Korteweg–de Vries–Kawahara equation and its convergence analysis are developed in the work by Koley. A computational-analytical method for Maxwell equations of electrodynamics for anisotropic materials is suggested in the paper of Yakhno et al.

Efficient numerical algorithms and their implementation specially designed for linear and nonlinear elliptic PDEs describing many real-life problems are also discussed. Thus, Daripa in his paper presents some application driven fast algorithms for various elliptic PDEs. In the paper by Kovács a comparison (and realization) of three iterative methods (together with some improvements) for some nonlinear elliptic problem is presented. The review of Karátson is devoted to main results in operator preconditioning for nonlinear elliptic equations with applications.

The paper by Pagliarani and Pascucci discusses the problem of pricing financial derivatives using short time asymptotics of the probability density function (or Green kernel) for local volatility models. This method is a modern approach to option pricing that has the potential to greatly improve some possibly very time consuming computations.

In the field of Numerical Linear Algebra, there are eight papers. The paper by Cortes et al. suggests an extension of the QR method to compute eigenvalues of a family of commuting matrices. Psarrakos and Tsatsomeros describe how for a given matrix to construct a certain set smaller (sometimes, much smaller) than its numerical range but still containing its spectrum. The advantage of this construction is a better estimate for the spectrum, at a price of a slight increase in computational complexity. The problem of deciding when a square nonnegative (element-wise) matrix is similar to some positive matrix is considered by Loewy. The answer is given for matrices of dimension four. Bru et al. revisit Brauer's theorem about how to modify one single eigenvalue of a matrix via a rank one perturbation without changing any of the remaining eigenvalues, and provide several interesting applications. The work by Farhadsefat et al. presents a sufficient nonsingularity condition for interval matrices which generalizes two previous known ones. Zhang et al. study the maximal and minimal inertias and ranks of a Hermitian matrix function. They also present several applications, among them – necessary and sufficient conditions for existence of Hermitian and bisymmetric solutions to some certain linear matrix equations. A new method of obtaining a banded system of equations for interpolation with a complete spline of degree $2n-1$ represented with B-splines is proposed by Volkov. Moreover, explicit formulas for calculation of n first and n last coefficients of B-spline representation are derived. The last paper in this section, by Lymbery and Margenov, focuses on constructing robust multilevel preconditioners for biquadratic FEM systems based on a semi-coarsening procedure. The derived theoretical estimates are uniform with respect to the anisotropy of the coefficient tensor of the orthotropic elliptic model problem.

The editors would like to thank the authors of all articles in this issue for their excellent contributions as well as many reviewers for their high-quality work with reviewing the manuscripts.