Fourth Symposium on ‘Recent Trends in the NumericalSolution of Differential Equations’: Preface

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Below, you can find some of the extended abstracts for the fourth edition of the symposium 'Recent Trends in the Numerical Solution of Differential Equations', which covers a wide range of topics related to the numerical solution of differential equations. In the following, we briefly describe the contents of the related papers.

Paper 1, by Davy Hollevoet, Marnix Van Daele, and Guido Vanden Berghe. The authors study the structure of the stability functions of multi- parameter exponentially fitted methods for differential equations. In particular, they extend the approach to *P*-stable multi-parameter exponentially fitted Obrechkoff methods. Due to the common structure of these stability functions, this result can very easily be reused for multi-parameter EF Runge-Kutta methods.

Paper 2, by Luigi Brugnano and Felice Iavernaro. The authors generalize the line-integral approach which the recently introduced class of energy-conserving methods called *Hamiltonian BVMS (HBVMs)*, for canonical Hamiltonian problems, rely on, thus obtaining a number of generalizations, collectively called *Line Integral Methods*. Such methods enable to preserve any number of invariants for general conservative problems. A few numerical experiments confirm the effectiveness of the proposed methods.

Paper 3, by Lidia Aceto, Paolo Ghelardoni, and Cecilia Magherini. The authors consider inverse Sturm-Liouville problems, in which the potential is recovered using the knowledge of suitable spectral data. In order to obtain an approximation of the potential, a sequence of direct problems is solved by methods in the family of BVMs. This procedure is then extended for the numerical solution of other problems, such as the *two-spectra* and the *half inverse* problems.

Paper 4, by Luigi Brugnano, Manuel Calvo, Juan I. Montijano, and Luis Randéz. The authors present and analyze energy-conserving methods for the numerical integration of initial value problems of Poisson type systems that enable to preserve some Casimirs. Their derivation and analysis is done within the framework following the ideas of *Hamiltonian BVMs (HBVMs)*. Sufficient conditions that ensure the existence of a unique solution of the implicit equations defining the formulae are given. A study of the implementation of the methods is provided.

Paper 5, by Paolo Novati. In this paper, the author investigates some practical aspects concerning the use of the Restricted-Denominator (RD) rational Arnoldi method for the computation of the core functions of exponential integrators for parabolic problems. A a useful a-posteriori bound that exploits the fast convergence of the Arnoldi method for compact operators is presented. Numerical experiments arising from the discretization of sectorial operators are discussed.

Paper 6, by J. Escartín and L. Rández. The authors present the class of numerical methods called *exponentially fitted explicit Runge-Kutta (EFRK)* schemes with the property of minimum storage requirements for systems with large dimension and oscillatory or periodic solution. A study of schemes of the minimum storage family of van der Houwen with orders $p \leq 4$ that require only two storage locations per variable is carried out. Then, two optimal EFRK formulae are proposed.

Paper 7, by A. Dick, O. Koch, R. März, and E. Weinmüller. The authors discuss the convergence behavior of collocation schemes applied to approximate solutions of BVPs in nonlinear index 1 DAEs, which exhibit a critical point at the left boundary. Such a critical point of the DAE causes a singularity in the inherent nonlinear ODE system. In particular, they focus on the case when the inherent ODE system is singular with a singularity of the first kind and apply polynomial collocation to to solve the original DAE system.

Numerical Analysis and Applied Mathematics ICNAAM 2011
AIP Conf. Proc. 1389, 215-216 (2011); doi: 10.1063/1.3636705

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Luigi Brugnano is professor of Numerical Analysis at the University of Florence, Italy. He graduated 'magna cum laude' at the Univeristy of Bari, Italy, in 1985. At the same University he started his scientific work, under the guidance of professor Donato Trigiante and, in 1990, he became a researcher at that University. In 1992 he moved to the University of Florence as an associate professor and, in 2001, he became full professor. His scientific activity has focused on several topics, such as: numerical linear algebra, numerical methods for polynomial roots, numerical methods for differential equations, parallel computing, numerical software, and mathematical modeling. He is the author of about 80 scientific publications, including four monographs.

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Ewa B. Weinmüller has been a member of the Analysis and Scientific Computing Department at the Vienna University of Technology since 1975. She studied mechanical engineering at the University of Technology in Poznan, Poland, and obtained her MSc degree in 1974. After moving to Austria in 1975 she continued her studies in technical mathematics and physics at the University of Vienna and Vienna University of Technology and completed them in 1979 with a Ph.D. degree advised by Hans J. Stetter. In 1987/88, she was a visiting professor at the Simon Fraser University in Burnaby BC, and in 1996 at the Imperial College in London. Since 2004 she is the coordinator and spokeswoman of the Research Unit "Numerics and Simulation of Differential Equations". Her research interests are analysis and numerical treatment of ordinary differential equations with singularities, especially a posteriori error estimates, defect correction algorithms, mesh adaptivity in the context of boundary value problems in ordinary differential equations and differential-algebraic equations and software development in Matlab. She is the author and co-author of more than 100 scientific publication.