Second Symposium on "Recent Trends in the Numerical Solution of Differential Equations": Preface

Luigi Brugnano

Dipartimento di Matematica "U. Dini", Viale Morgagni 67/A, 50134 Firenze (Italy)
`http://www.math.unifi.it/~brugnano/`

Most of the topics covered by this symposium deal with the numerical solution of ODE-IVPs, a field of research in which many contributions are due to Ernst Hairer, whose $60th$ birthday is celebrated in this 2009 edition of ICNAAM. In particular, there are a number of talks devoted to the numerical solution of Hamiltonian problems, one of the Ernst's favourite field of investigation, in recent years.

Many topics are, however, covered by the talks in this second edition of the symposium, which can be roughly collected as follows:

- numerical methods for Hamiltonian problems (papers 1, 3, 5, and 9);
- numerical methods for ODE-BVPs (papers 2 and 12);
- numerical methods for problems deriving from the semi-discretization of PDEs (papers 4 and 10);
- numerical solution of DAEs (paper 6);
- a new definition of *stiffness* with applications (paper 7);
- numerical methods for dynamical systems possessing a Lyapunov function (paper 8);
- numerical methods for variational inequalities (paper 11).

In the following, we briefly describe the contents of the various papers, listed in alphabetical order of the respective speakers.

Paper 1, by <u>L. Aceto</u> and D. Trigiante. The authors study the possibility of obtaining discrete periodic or quasi-periodic solutions when approximating Hamiltonian problems, in order to avoid a possible drift in the Hamiltonian function. They highlight the existing connections with a classical problem of evolution of planar polygons.

Paper 2, by <u>P. Amodio</u> and G. Settanni. Here, it is studied a cheap error estimate, when using generalized upwind methods for solving second-order BVPs. The considered methods discretize directly higher-order derivatives by means of suitable Boundary Value Methods (BVMs).

Paper 3, by <u>L. Brugnano</u>, F. Iavernaro, and D. Trigiante. The authors describe the newly introduced class of methods called Hamiltonian BVMs (HBVMs), able to numerically preserve polynomial Hamiltonians (see also paper 5). The presented methods can be also regarded as a generalization of collocation methods.

Paper 4, by <u>S. Gonzáles-Pinto</u> and S. Pérez-Rodrigues. Here, in the framework of MoL, the authors study time-adaptive Radau methods for Advection-Diffusion-Reaction PDEs. The presented approach is numerically compared with other known solvers.

Paper 5, by L. Brugnano, <u>F. Iavernaro</u>, and T. Susca. The authors describe the efficient implementation of HBVMs, the methods presented in paper 3. Such methods are able to numerically preserve polynomial Hamiltonian functions by means of the introduction of a suitable number of "silent stages".

Paper 6, by <u>R. Lamour</u> and D. Monett Diaz. Here, the efficient use of Automatic-Differentiation is studied for index determination, in connection with the numerical solution of DAEs. Comparisons with other index determination algorithms, on an illustrative example, are given.

Paper 7, by L. Brugnano, <u>F. Mazzia</u>, and D. Trigiante. The authors describe a very general definition of *stiffness*, and its impact when designing numerical codes for ODEs. The new definition encompasses all the previous ones, and naturally extends to BVPs.

Paper 8, by M. Calvo, P. Laburta, J.I. Montijano, L. Rández. Here, the authors study efficient Runge-Kutta methods, provided with a continuous extension and a projection technique, in order to efficiently integrate ordinary differential equations with a known Lyapunov function.

Paper 9, by E. Celledoni, R. McLachlan, B. Owren, and R. Quispel. The authors study the structure of B-series for integrators which are conjugate to symplectic or energy preserving methods, proposing to study the modified vector fields of such methods as filtrations.

Paper 10, by M. Calvo, J.M. Franco, J.I. Montijano, and L. Rández. In this paper, new finite difference schemes for the spatial discretization and time advancing RK schemes for the numerical simulation of Computational Aero-Acoustic problems are studied.

Paper 11, by L. Brugnano and A. Sestini. The authors present the efficient modeling of obstacle problems by means of the so called "Piecewise Linear Systems". The latter are linear systems, whose coefficient matrix is a piecewise constant function of the solution itself.

Paper 12, by M. Van Daele, D. Hollevoet, and G. Vanden Berghe. Here, multiparameter exponentially-fitted Numerov methods applied to second-order boundary value problems are analysed. In particular, the proposed approach is aimed to overcome some drawbacks of classical exponentially-fitted methods.