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Preface

At the 13th IMACS World Congress on Computation and Applied Mathematics (held at Trinity College, Dublin, July 22–26, 1991), three sessions on numerical methods for ordinary differential equations (ODEs) were organized, containing, in total, 22 papers. This concentration of research papers suggested the possibility of publishing a selection of them in a special issue of a scientific journal. This idea, as an alternative to inclusion of these papers in the IMACS Transactions of the Congress, was discussed with Prof. R. Vichnevetsky, the president of IMACS. Professor Vichnevetsky agreed that such a special issue was justified and he suggested contacting Drs. A. Jongejan of Elsevier Science Publishers B.V. and Prof. L. Wuytack, Principal Editor of the North-Holland *Journal of Computational and Applied Mathematics*. Their support in devoting a special issue of the journal to a number of the Dublin contributions on numerical ODE solvers is highly appreciated.

The refereeing of the Dublin papers submitted for publication in this special issue was handled by the three session organizors who also acted as editors. Our final selection consists of eighteen papers which can be classified into four groups: analysis of (i) initial-value problem (IVP) solvers, (ii) boundary value problem (BVP) solvers, (iii) parallel IVP and BVP solvers, and (iv) implementation questions.

The first group of papers on IVPs consists of seven papers. Auzinger, Frank and Kirlinger review theoretical approaches to, and results on, convergence and error structures for stiff IVP solvers. Burrage and Chan discuss a smoothing technique for suppressing the loss of accuracy observed for implicit Runge–Kutta (RK) methods when applied to singularly perturbed problems. Calvo, Montijano and Rández consider the A_0-stability properties of three versions of the BDFs, viz., BDFs of interpolatory, of variable-coefficient and of fixed-leading-coefficient type. Cash and Semnani present a nonstiff (or mildly stiff) version of the modified extended backward differentiation formulas (BDFs) of Cash. Dieci investigates the suitability of various numerical integration methods for solving symmetric differential Riccati equations occurring in optimal control applications. Eirola introduces a backward error analysis approach to the study of the accuracy of IVP methods (the "modified equation" approach used in the analysis of partial differential equation solvers). Vermiglio constructs pth-order interpolants for RK methods by using the values furnished by the RK method on N successive intervals of integration and provides estimates of the minimum value of N.

The second group on BVP methods consists of two papers. Cash and Silva examine the efficiency of deferred correction based on mono-implicit RK methods for first-order systems of nonlinear two-point BVPs and in particular look at singular problems. Liu and Russell

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investigate the stability properties of several linear system solvers for solving BVPs and discuss the effect of the continuation strategy and of the mesh selection.

The third group of papers on parallel IVP and BVP methods consists of six papers. Bellen, Jackiewicz and Zennaro look at waveform relaxation type methods (time-point relaxation) for use on parallel architectures and present stability regions for the case where the underlying time integrator is an RK method. Burrage investigates predictor-corrector (PC) methods for nonstiff problems and shows that block PC methods can be efficiently implemented on a parallel system if the predictor is of sufficiently high order. Sommeijer reports results of a parallel, diagonally implicit iteration scheme for solving the implicit relations in RK methods and compares his parallel PSODE code with the sequential codes LSODE, RADAU5 and SIMPLE. Crisci, Russo, van der Houwen and Vecchio apply a similar parallel iteration scheme to implicit Volterra–Runge–Kutta (VRK) methods and present stability results for VRK methods of Pouzet type. Gladwell and Paprzycki report numerical results of a new level 3 BLAS algorithm for almost block diagonal systems when implemented on a CRAY Y-MP. Using ideas similar to recursive-doubling and block-cyclic reduction, Wright describes a parallel algorithm that reduces a block-bidiagonal system of size n^2+n to a system with two-dimensional blocks.

Finally, the fourth group of papers is devoted to implementation questions for IVP methods and consists of three papers. Butcher and Johnston discuss local truncation error estimates for RK methods and propose an alternative to the embedded-formula approach by generalizing a method of Ceschino and Kuntzmann. Cooper and Vignesvaran examine a linear iteration scheme for solving the implicit relations in RK methods and report results for the Gauss–Legendre methods. Higham looks at explicit RK methods and shows that with any standard error control method, the global error in the numerical solution essentially behaves like a known rational power of the error tolerance.

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Guest Editors