Part II

NUMERICAL MATHEMATICS
STABILITY OF SOME BOUNDARY VALUE METHODS FOR THE SOLUTION OF INITIAL VALUE PROBLEMS

P. AMODIO¹, F. MAZZIA¹ and D. TRIGIANTE²

¹ Dipartimento di Matematica
Università di Bari
Via E. Orabona, 4
70125 Bari, Italy

² Dipartimento di Energetica
Università di Firenze
Via C. Lombroso, 6/17
50134 Firenze, Italy

Abstract.

The stability properties of three particular boundary value methods (BVMs) for the solution of initial value problems are considered. Our attention is focused on the BVMs based on the midpoint rule, on the Simpson method and on an Adams method of order 3. We investigate their BV-stability regions by considering the scalar test problem and constant stepsize. The study of the conditioning of the coefficient matrix of the discrete problem is extended to the case of variable stepsize and block ODE problems. We also analyse an appropriate choice for the stepsize for stiff problems. Numerical tests are reported to evidentiate the effectiveness of the BVMs and the differences among the BVMs considered.


Key words and phrases. Ordinary Differential Equations, Initial Value Problems, Numerical Methods, Stability.

1. Introduction.

An interesting approach for the solution of ODEs seems to be the approximation of the initial value problem with a boundary value method (BVM) [2, 6, 7]. As recently outlined, these methods have some advantages with respect to the initial value methods as, for example, the control of the global error, the possibility to use the same method for stable and unstable problems, an efficient parallel implementation.

The basic idea of the BVMs is to re-formulate the initial value problem as a boundary value one, by using an approximation of the unknown last point. Lopez and Trigiante in [6] give some theoretical results about the stability properties of BVMs based on two step methods. In the linear case, these methods lead to a linear