Numerical methods for ODE

1. Heat conduction equation and its semi-discretization, qualitative properties.

2. Stability, stiff systems of ODE.

3. Taylor method as numerical method.

4. Explicit Euler method and its properties. (Consistency and convergence on uniform and non-uniform meshes.)

5. Implicit Euler method, trapezoidal rule.

6. Absolute stability, A-stable numerical methods. (Stability domain of the methods, A-stability of the linear systems, example of the semi-discretized heat equation.)

7. Basic of the Runge-Kutta methods. (Basic idea, some simple methods.)

8. Runge-Kutta methods in general form. (Butcher tableau, conditions of the consistency, relation between the stage and order numbers, convergence.)

9. Absolute stability of the explicit Runge-Kutta methods.

10. Matlab programs for the RK methods.

11. General theory of two-points boundary-value problems.

12. Shooting method.

13. Linear boundary-value problems and their numerical solution.

14. Implicit Runge-Kutta (IRK) methods

15. IRK methods for the stiff problems, their A-stability. Padé-type schemes.

16. Basic of the linear multistep methods, Adams methods.

17. The Adams-Bashfort-method and its consistency.

18. Implicit methods (Adams-Moulton and the backward difference methods, their realization.)

19. Stability of the general linear multistep methods. (Zero stabalitiy, strong and weak stability).

Budapest, 2019 May

Faragó István