LYAPUNOV FUNCTION BASED STEP SIZE CONTROL FOR NUMERICAL ODE SOLVERS

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EXTENDED ABSTRACT. In this talk we describe methods for stability preserving step size control methods for numerical one step schemes for ODEs. The key idea is to select the step size such that a Lyapunov function for the ODE is guaranteed to be also a Lyapunov function for the numerical approximation.

If a Lyapunov function for the ODE is known, then this technique can be used in order to design adaptive step size algorithms similar to (and complementing) those based on local error estimates. If no Lyapunov function is known, then the method may be used in order to deduce qualitative properties which we will demonstrate, e.g., by deducing a nonlinear generalization of the A-stability property for the implicit Euler scheme.

Several applications will be presented with a particular focus on ODEs which are designed to solve optimization problems and for which our method can guarantee (semi-)global convergence properties of the numerical approximation.

The talk will be based on [1] extended by newer results.

REFERENCES

[1] I. Karafyllis and L. Grüne, *Feedback stabilization methods for the numerical solution of systems of ordinary differential equations*, Discrete Contin. Dyn. Syst. Ser. B, 16 (2011), pp. 283–317.

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