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15. Numerical Analysis and Scientific Computing

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How to control the global error of Runge-Kutta methods
In this paper we develop a new procedure to control stepsize for Runge-Kutta methods. In contrast to the standard approach, the error control mechanism presented here is based on monitoring and controlling both the local and global errors of Runge-Kutta formulas. As a result, Runge-Kutta methods with the local-global stepsize control solve differential or differential-algebraic equations with any prescribed accuracy (up to round-off errors).
For implicit Runge-Kutta formulas we give the sufficient number of both full and modified Newton iterations allowing the iterative approximations to be correctly used in the local-global stepsize control. In addition, we develop a stable local-global error control mechanism which is applicable for stiff problems.