
Applied Numerical Methods - Computer Lab 2

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Part A. Accuracy of a Runge-Kutta method

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Part B. Stability investigation of a Runge-Kutta method

In this section, we will investigate the stability of a Runge-Kutta method. We will study a stiff problem, the Robertson's equations. As a remainder, here is the problem :

$$\begin{aligned} \mathbf{x}' &= \begin{pmatrix} -k_1 x_1 + k_2 x_2 x_3 \\ k_1 x_1 - k_2 x_2 x_3 - k_3 x_2^2 \\ k_3 x_2^2 \end{pmatrix} \\ \mathbf{x} &= \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix} \end{aligned}$$

The problem is stiff because of the practical values of the parameters. In this example, we have $k_1 = 0.04$, $k_2 = 10^4$ and $k_3 = 3 \cdot 10^7$.

B1. Constant stepsize experiment

We are going to solve the Robertson's problem first with a constant stepsize.

Part C. Parameter study of solutions of an ODE-system

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