

Group 61
Modelling and simulation
EES101 Assignment 3

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1 summary

2(a) An explicit Euler scheme euler, and an RK2 and RK4 scheme

When comparing the euler, RK2, and RK4 methods, we can see that the accuracy increases as the order of the method increases. the RK4 method is so close to the exact solution when comparing with the other solutions.

2(b) To Plot the accuracy

By comparing the global error of the RK schemes for the Δt , we can find that the global error decreases as the order of the RK method increases which means that the when the order increases, the accuracy also increases. Hence, the Rk4 method gives some accurate solution when comparing with the other RK solutions. Also, the RK4 solution gives results very close to the true solution.

2(c) stability

Given that the $\Delta t = 0.1$, the stability is given by

$$S = \left\{ \lambda \Delta t \quad \text{s.t.} \quad \left| \sum_{k=0}^{\infty} \frac{(\lambda \Delta t)^k}{k!} \right| \leq 1 \right\}$$

By solving this equation in the code, the lambda value for the all the schemes are for euler scheme

by solving for euler scheme $\lambda = -20$

RK2 scheme $\lambda = -20$

RK4 scheme $\lambda = -27.5$

3(a)van der pol

we consider the non linear dynamics equation given in the question for the van der pol From the figure 1, we can observe that, the graphs are benign most of the time and going through some sharp changes. van der pol oscillator is challenging ODE for the numerical integration as very fine time steps are need to survive.