# Numerical Methods in Engineering and Applied Science. Assignment 3.

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1. (max. 1 point) Find a quadratic polynomial p(t) that satisfies the following conditions:

Which time-stepping method do you obtain if you assign ? Write a formula and name it.

It is the trapezoidal rule (order 2).

1. Consider a family of multi-step methods

where θ is a parameter.

1. Determine the order of consistency and the error constant of the method. Show that both do not depend on θ.

Let’s use Taylor expansion for , consider that .

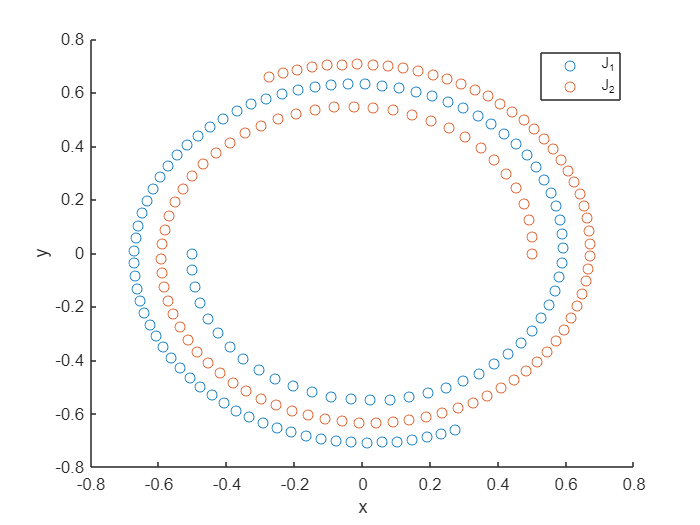
After that subtract the right-hand side from the left. (all calculations in the program)

So, the order of consistency is 1. ( doesn’t depend on )

1. For which values of θ is the method convergent?

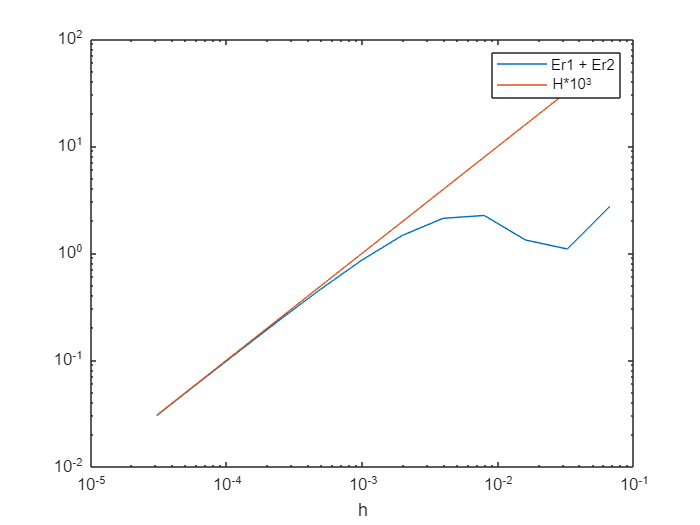
As far as and if it is simple: => method is zero stable +consistent =>it is convergent.

1. Using the explicit Euler method, calculate the time evolution of (xj,yj ) with t ∈ [0,1] and plot y1(x1), y2(x2). On a separate plot, show the convergence of the results of the calculations at t = 1 versus the discretization step h.



J1 is the first vortex, J2 is the second.

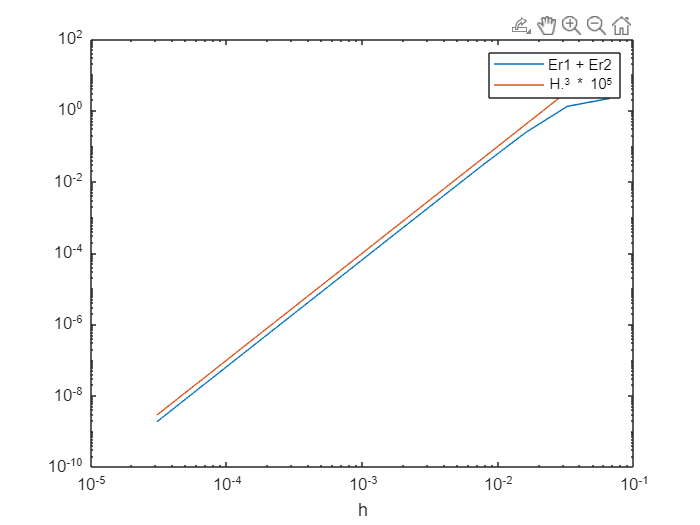
Solution must be periodic, therefore .



First order convergence.

1. Redo the same calculations using a third-order Runge–Kutta Method

Show the convergence plot with respect to h using the logarithmic scale and comment on the slope of the line that you obtain.



You can see 3rd order convergence. So, 3rd Runge-Kutta – 3rd order convergence.