EE2-08C Numerical Analysis

Group 9

Exercise 1

This simple RL circuit forms a high pass filter circuit which takes an input signal Vin and only allows the high frequency components to pass. Despite the inductor being less convenient than a capacitor, this RL circuit can approach the model of a DC motor. In this specific case, we want to model a DC motor with inertia 250 μsNm/s^2 and $T_{max} = 50mNm/A$. To do so, according to KCL, we know that

$$Vin(t) = v_L(t) + v_R(t)$$

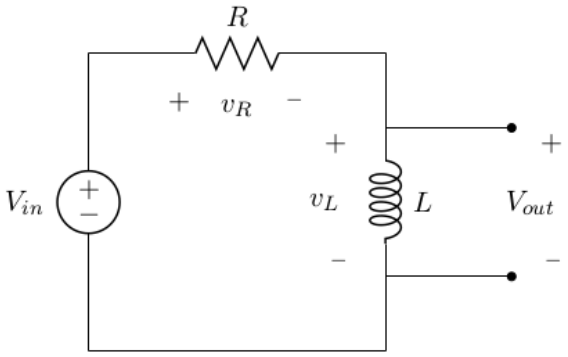

Figure 1: RL Circuit

and therefore:

$$V_{in}(t) = L\frac{d}{dt}i_L(t) + Ri_L(t)$$

$i_L(t)$ is the state that we will solve following the three different second-order Runge Kutta methods. All methods follow the same pattern:

$$x_{i+1} = x_i + h$$

h being the step size and

$$y_{i+1} = y_i + h(ak_1 + bk_2)$$

where

$$k_1 = f(x_i, y_i)$$

$$k_2 = f(x_i + ph, y_i + qk_1h)$$

and the values of a, b, p and q depend on which method we are using:

Parameter	Heuns	Midpoint	Ralston
a	1/2	0	1/4
b	1/2	1	3/4
p	1	1/2	2/3
q	1	1/2	2/3

Each method will approximate the exact solution according to these parameters. Therefore, the smaller the step size h, the more exact the method will approximate the solution.
After doing so, the output value will be obtained as follows:

$$V_{out} = V_{in}(t) - Ri_L(t)$$