JED-I

How to Control Electromechanical Systems

Assignment # 1

RLC circuit in State Space form

To express the governing equation of the RLC circuit in state space form, follow the steps outlined below:

1. Decide upon the state variables. You can take charge and current or capacitor voltage and current or any other combination as long as the two variables are independent.

2. Write the Kirchoff's voltage law and find the A and B matrices.

3. Decide what is the output variable (of interest). Depending on the chosen output variable, write the C and D matrices.

For example, if we choose q and i as the variables and voltage across capacitor V_c as output then our C matrix is $[1/C, 0]$ where C is the capcacitance.

If we choose voltage across resistor V_R as the output then the C matrix becomes [0,R] where R is the resistance.

4. Once the A, B, C and D matrices are written, simulate it in python for impulse input taking R = 0.

When R is zero, there is no damping and we expect oscillatory behaviour. You should get only complex part in the eigen values.

5. Now you can take a non-zero value of R and re-run.

6. Repeat these simulations for a unit step input.

Submit a report containing hand-written description of state space form of the RLC circuit. Attach a printout of system response to a unit step input with R = 1000, L = 10^{-3} Henry, C = 10^{-6} Farads.

Also include answers to the following questions:
For this case, did you get an oscillatory response? Why? Is this system over damped? What is the damping ratio? What are the eigen values?