ELEC 341 – Graded Assignments

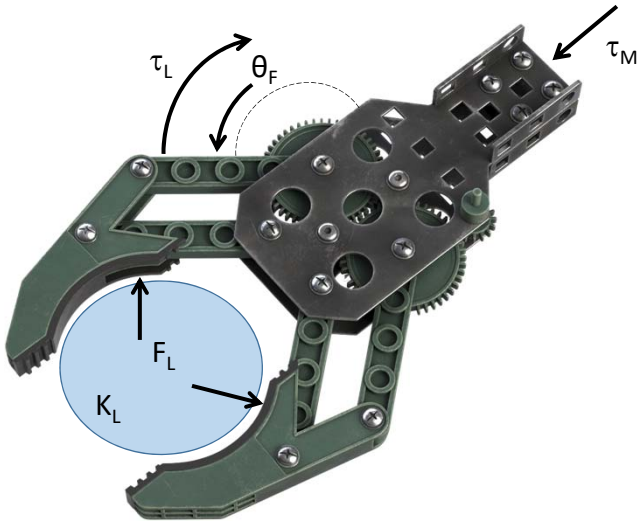
Project P-3

8 Marks

Learning Objectives

- Using Nodal Analysis to Solve Transfer Function of Actuated Gripper
  - Simplified Motor Model
  - Motor Angle
  - Finger Angle

Gripper & Ball



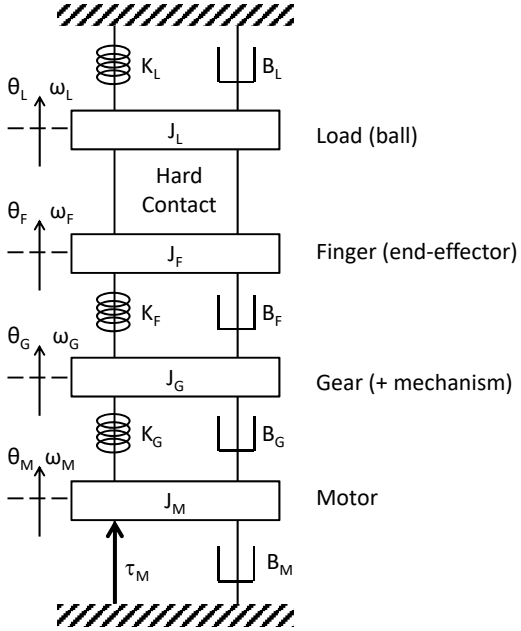
Mechanical Circuit of Gripper

- JG = #Ax75 mg-cm^2
- JF = #Bx25 mg-cm^2
- JL = 60 mg-cm^2

- BG = #Cx2 g-cm^2/s
- BF = #Dx400 mg-cm^2/s
- BL = 500 mg-cm^2/s

- KG = #Ex3000 Kg-cm^2/s^2
- KF = #Fx1800 Kg-cm^2/s^2
- KL = 2500 Kg-cm^2/s^2

- JM = From Maxon data-sheet
- BM = 0 (for now)
- τM = 1 Nm (per-Unit)



A robot gripper is shown grasping a rubber ball. A simplified mechanical circuit representing the gripper and ball is also shown.

τM is the torque applied by the motor.

FL is the load force applied by the ball to the finger, as a result of the ball stiffness KL.

Only half of the symmetrical gripper is included in the model for the sake of simplicity.

Equivalent Electric Circuit

Transform the Mechanical Circuit into an equivalent Electric Circuit.

- Draw the electric circuit
- Annotate it with component labels (R1, L1, C1, etc.)

Mechanical Y of Loaded Motor (with Gripper)

You are using the **12V** motor on **page (#A+70)** of the Maxon Catalog.
Use nodal analysis to compute the following transfer function.
Use **minreal()** to cancel any common factors.

- P3_Ym = $\omega M/\tau M$ = Motor Speed / Motor Torque (rad/Nms)

Use the Maxon Motor catalog posted on Canvas. Use the 2020/2021 version.

*Don't get a new copy from **maxongroup.com** because the page numbers are different.*

Step Response

Generate the step response of the following angles.
Plot both on the same figure.
Apply a step with a torque that is ½ of the Stall Torque of your motor.

- θ_M
- θ_L
- All Angles (deg)
- Time (sec)

Don't forget – Ym delivers speed, not angle, for an applied torque.

*Matlab has function called **dcgain()** which should match what you see on your plots.*

Is there an easy way to make sure you are getting a realistic value ???

Consult your electric circuit and figure out how much DC current you expect. This is ball torque. How much should it be compressed to deliver this ???

Do the 2 plots vary much from one another ??? Is this what you expect ???

Consult the mechanical circuit and imagine what it would do if you built it exactly as shown and applied the force with your finger.

Deliverables

Values

- P3_Ym (3 marks)

Figures

- Equiv Elec CCT (2 marks)
- Step Responses (3 marks)