Elec 391 – 2022-W2

Mini-Project Description

Jan –Apr 2023

Software

- Design Pendulum
- Draw Motor
- Simscape Model

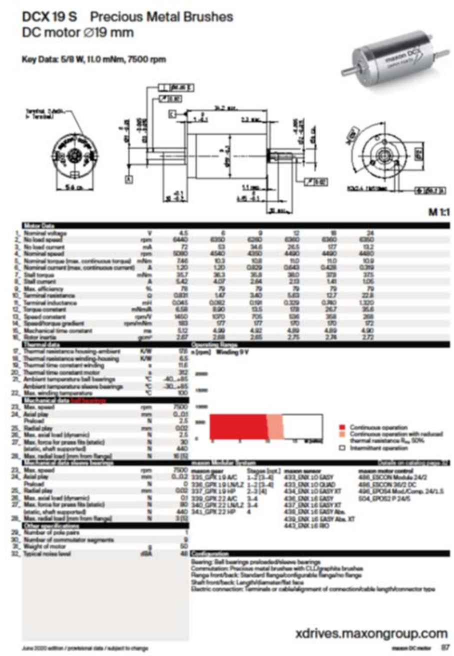
Hardware

- Program PLD
- Demo PLD on Breadboard
- Draw PCB

Software System

Identify motor using maxmot.p

- Physical Dimensions
- Winding R & L
- Rotor Inertia
- Robot Friction
  - Dynamic only
  - Model as linear damper

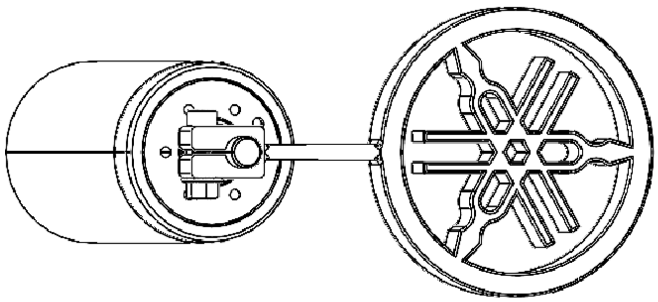


maxmot.p

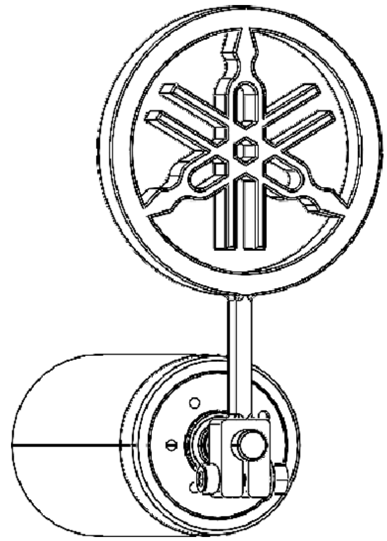
- Download from Canvas
- Enter Student Number
- Look up Page & Voltage from DCX catalog

Design Pendulum: SolidWorks

Source: YAMAHA



Start Angle = 0°



End Angle = 90°

<u>Download motor model</u>

- maxongroup .com
- Brushed DC motor
- STEP file
- Create simplified model

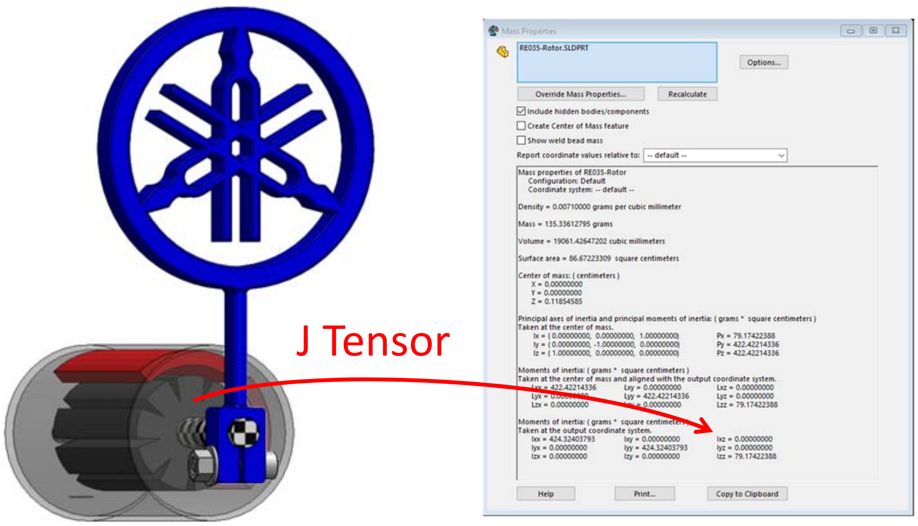
<u>Custom Pendulum</u>

- Pendulum contains logo of your choice
- Show source where you copied Logo
- Fits motor shaft
- Reasonable length
- 3003 Aluminum
- Compute Mass, Mass Centre, Inertia

<u>SolidWorks Assembly File</u>

- Motor (from Maxon)
- Pendulum
- Fasteners (from McMaster Carr)

Generate Motor & Simscape Model: SW



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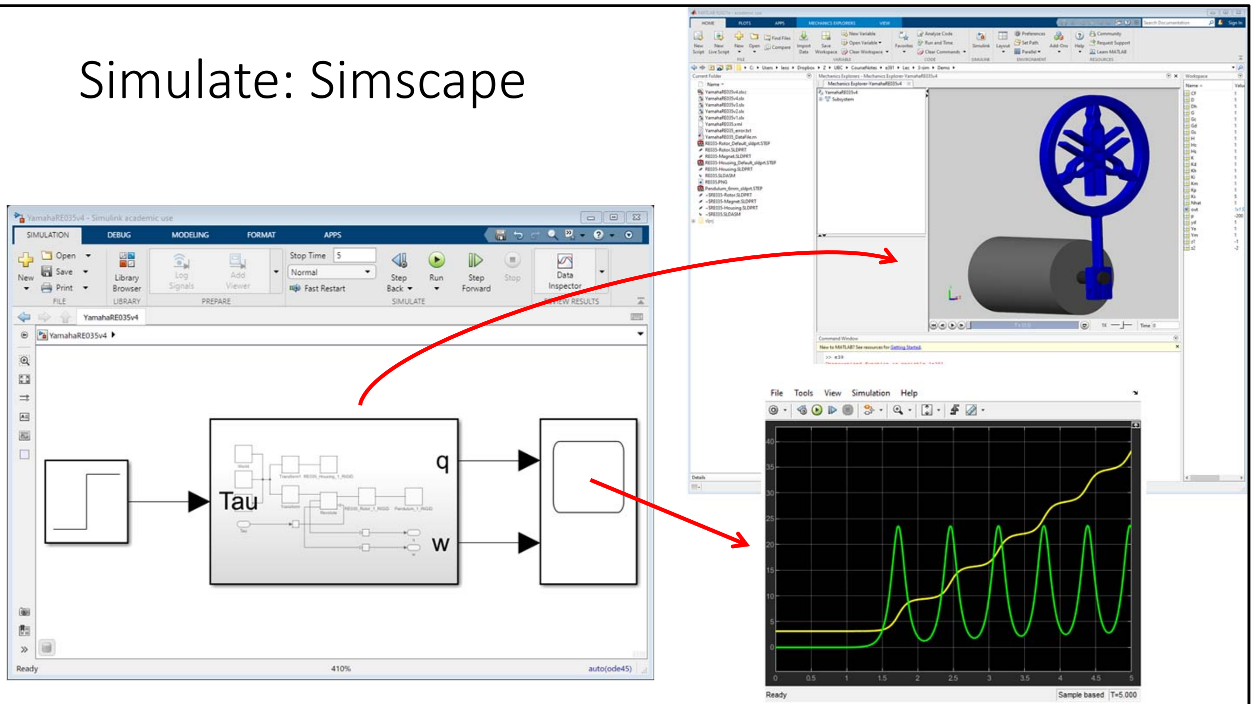
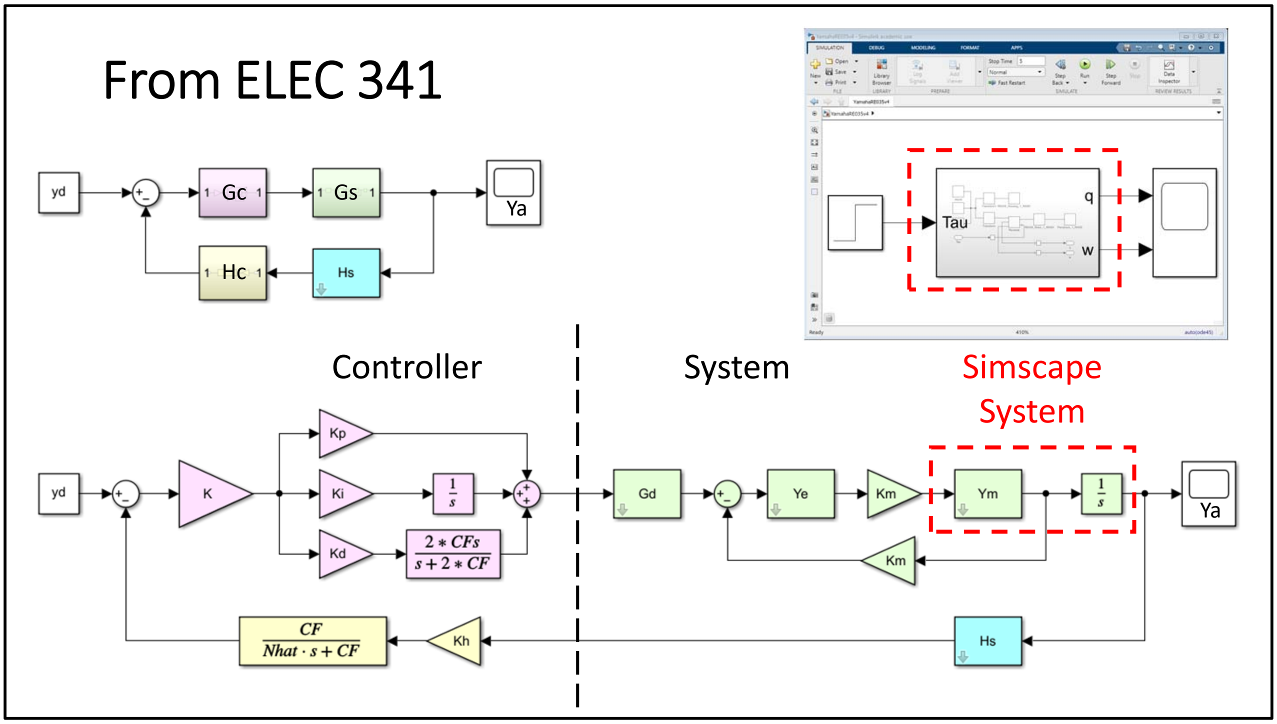
Simulate: Simscape



<u>Configure Simscape model</u>

- Mechanical parameters
- Inputs & Outputs
- Simulate
  - Animation
  - Plot Results

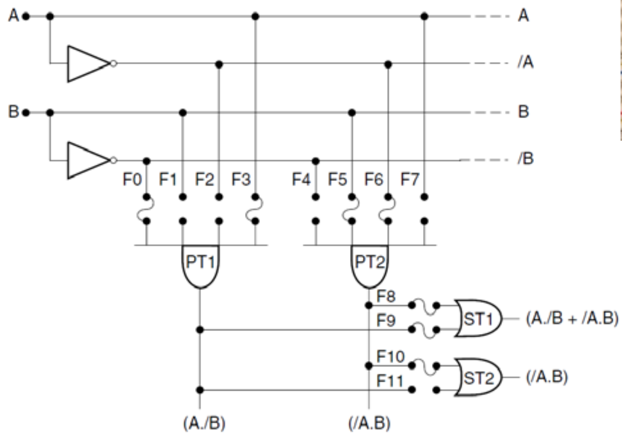


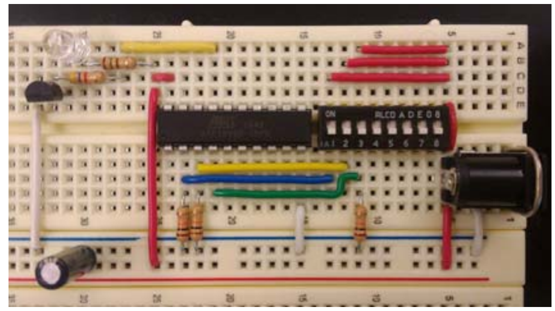
<u>How is this used?</u>

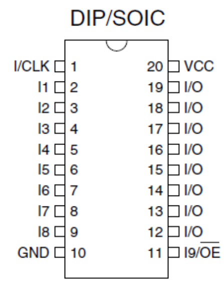
- Identify System
  - Develop Ym transfer function
- Compare to Simscape Model
- Use Ym to design controller
- Replace Ym and 1/s blocks in “rubber-stamp” control system model with Simscape Model
- Add non-linearities to Simscape Model
- Re-tune controller (Heuristic)
- Animate (Demonstrate)
- Compare to REAL system

Hardware System

Figure 1-3. Elementary PLA architecture

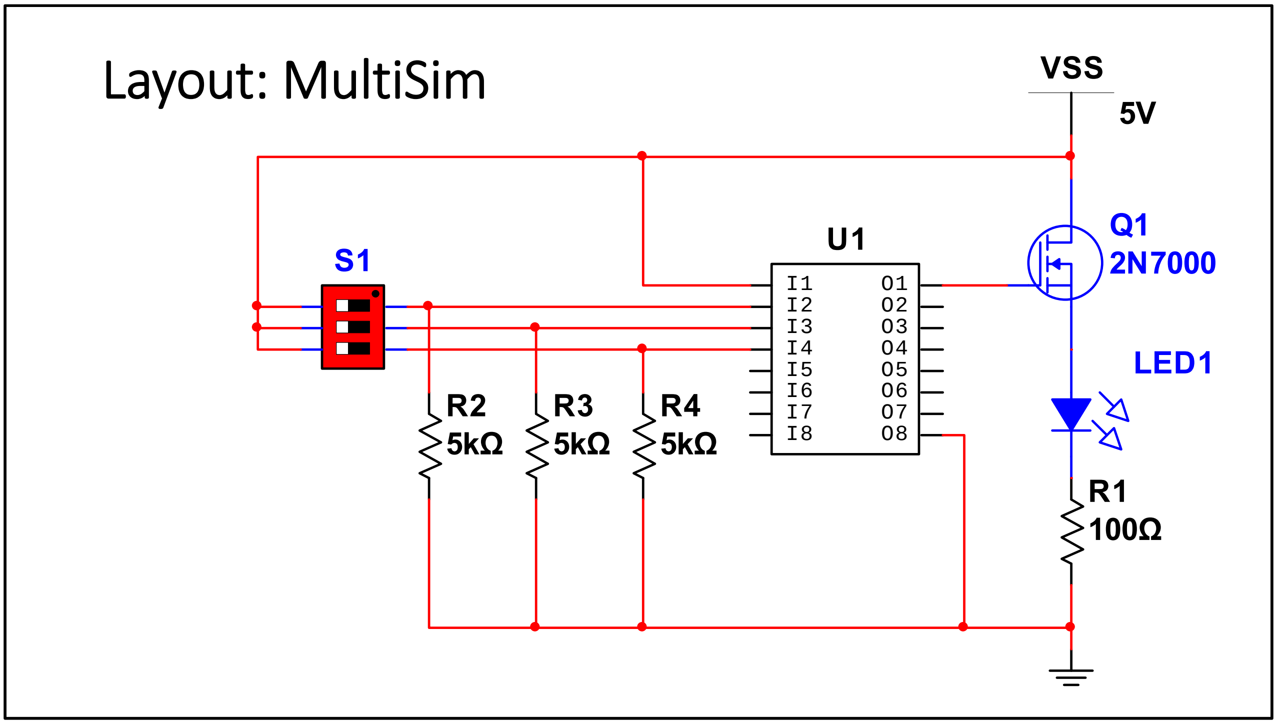






<u>Programmable Logic Device</u>

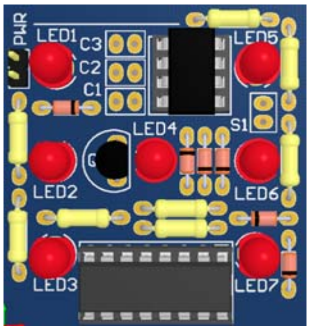
- Any logic circuit
- At least 3 different logical operators
- Design
- Simulate
- Demonstrate on breadboard

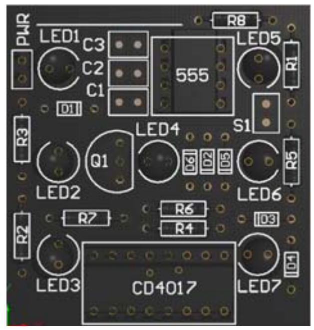


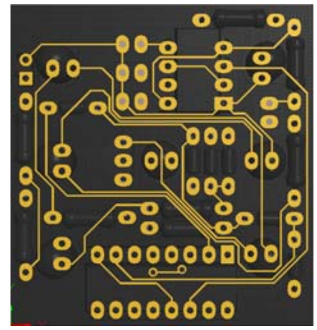
MultiSim Circuit

- Logic 1 = ON
- Logic 0 = OFF
- External power source

Design PCB: UltiBoard



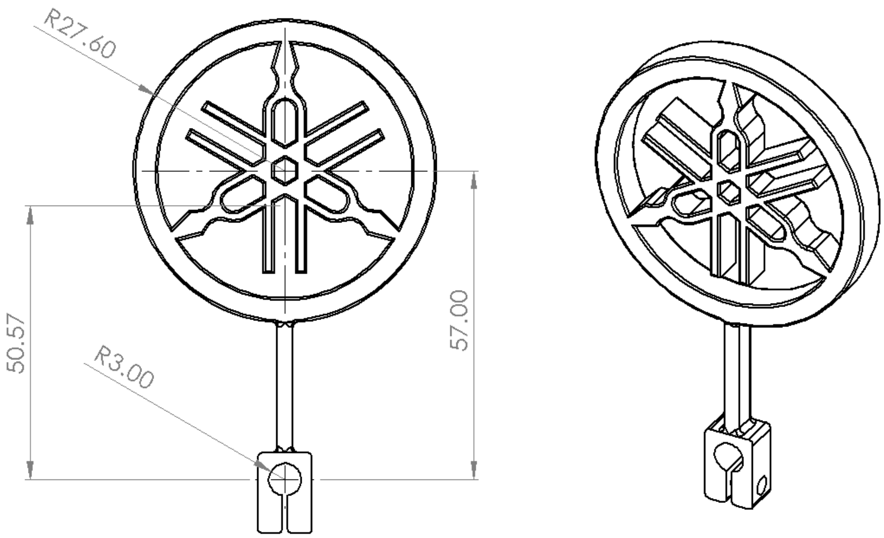




<u>UltiBoard</u>

- Layout PCB
- 2-Sided
- No wasted space
- Labels (silk screen layer)
- Connectors
- Mounting holes

Documentation



PPT Slides

- Evidence of work done
- At least 1 slide / task
- Slide-Deck Format
    - See e391ReportFormat.pdf

Software Mini-Project

1. Use maxmot.p to select Maxon motor.
2. Configure & download step file from Maxon motor.
3. Choose symbol to draw.
4. Use SolidWorks to design pendulum.
5. Re-draw motor rotor & stator.
6. Download fasteners from McMaster Carr.
7. Create assemblies.
8. Create configurations.
   a. Maxon
   b. Detailed
   c. Minimal
9. Export Minimal configuration to Simscape Multibody Link (SML).
10. Import into Simulink model.
11. Simulate position control.
12. Simulate force control.

Hardware Mini-Project

1. Design a simple logic circuit that involves at least 3 different logic gates.
2. Draw the truth table.
3. Use WinCUPL to develop code.
4. Use WinSim to simulate code.
5. Use Superpro 610p to burn code onto IC (provided by lab TA).
6. Use breadboard to demonstrate logic function.
7. Use MultiSim to draw breadboard circuit. Replace PLD with associated 74xx Ics.
8. Simulate circuit.
9. Export circuit to UltiBoard.
10. Layout 2-sided PCB.
11. Add a silk screen layer.
12. Add connectors, switches, and any other components to make it a usable board that is powered by a bench power supply.