Project Work

The Egg Drop Experiment

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Challenge	Lower an egg from 20cm height to the ground without breaking the egg. Fastest time wins.
Competition Rules	Use DC motor from Sparkfun kit. You can break as many eggs as you like. You have three attempts in the competition.

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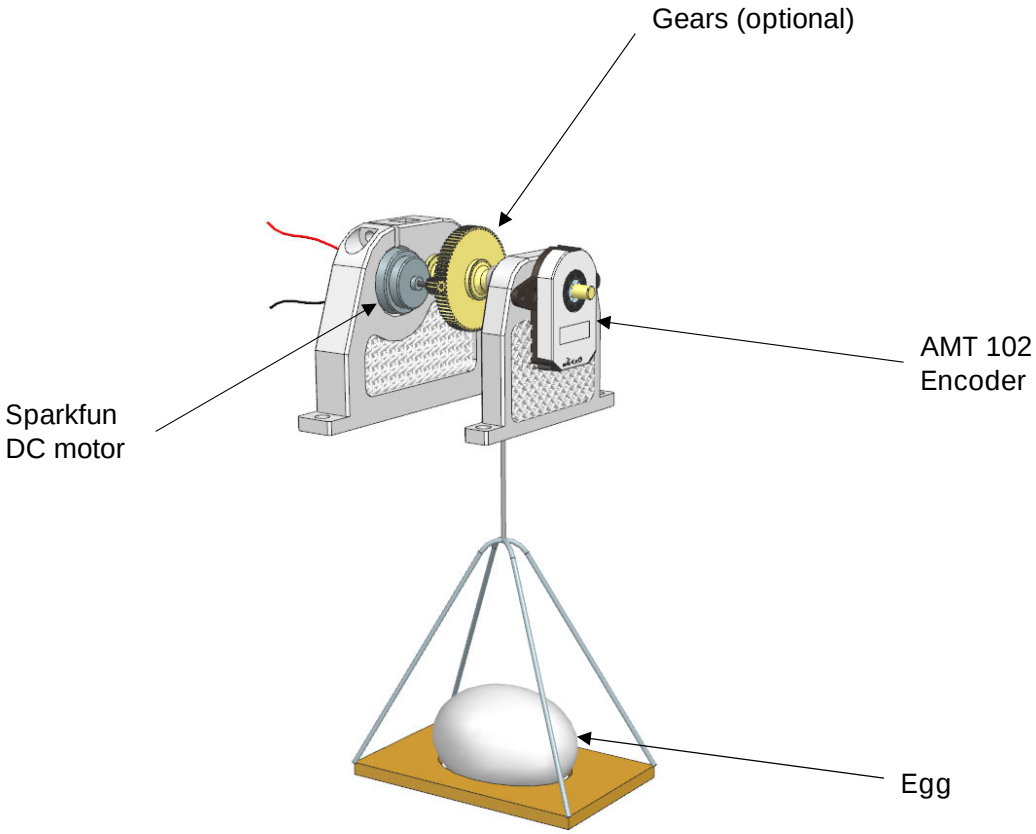
Setup



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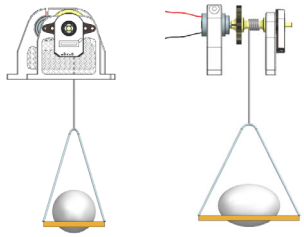

Project Description:
System Identification of
DC Motor

The task is to estimate system parameters for a DC motor using an Arduino Uno microcontroller. The project consists of the following steps:

(1) Set up the circuit with components from provided schematic.

(2) Write Arduino program code for controlling the DC motor with Pololu TB67H420FTG motor driver, and record shaft angle using rotary AMT 102V encoder.

(3) Perform experiments for generating input (voltage) and outputs (shaft angle). Save in- and outputs to file that can later be imported to Matlab (we should provide an independent validation dataset).

(4) Import data in Matlab, and perform system identification.

(5) Tune PID-controller with identified system, and try it out on the DC-motor.

(6) Present findings in final presentation, and compete in egg drop challenge**. Date: 19.09.23!**

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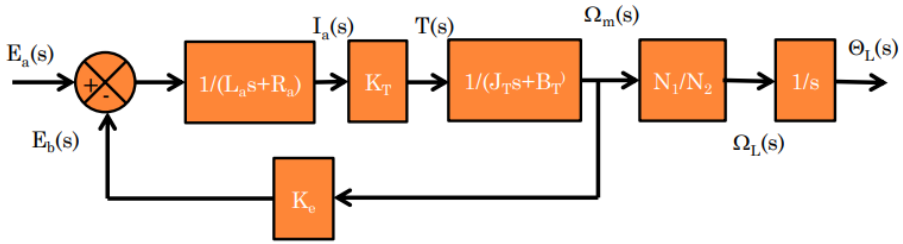
Project Description:
System Identification of
DC Motor



Θ_L is motor position.
E_a is armature voltage.
K_T is motor torque constant.
N_1 and N_2 is gear ratio.
J_m is motor inertia.
L_a is armature inductance.
B_m is motor friction.
R_a is armature resistance.
K_E is back emf constant.

$$\frac{\Theta_L(s)}{E_a(s)} = \frac{K_T\left[\frac{N_1}{N_2}\right]}{J_m L_a s^3 + (B_m L_a + J_m R_a)s^2 + (B_m R_a + K_E K_T)s}$$

Full derivation of model:
https://www.engr.siu.edu/staff/spezia/Web438A/Lecture%20Notes/lesson14et438a.pdf
(Spezia, Southern Illinois University Carbondale, visited 30.08.2021)

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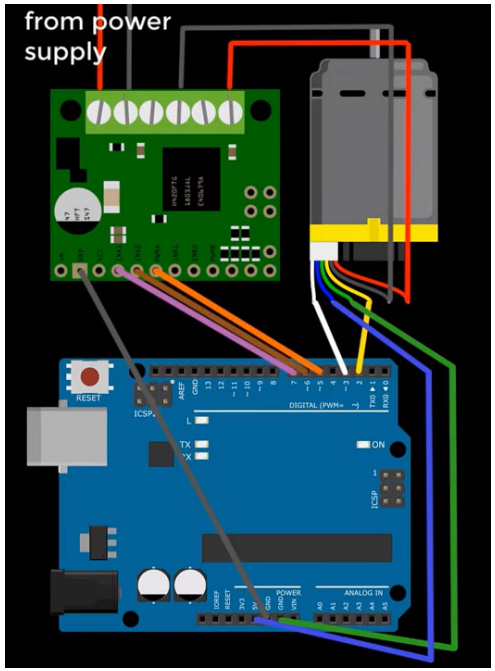
Hardware

Arduino Uno microcontroller (or similar)
Pololu TB67H420FTG motor driver (or build your own circuit)
Sparkfun DC motor
AMT 102V rotary encoder
External Power supply
Mechanical parts
Egg



Resources

Circuit and coding tutorial:
https://www.youtube.com/watch?v=dTGITLnYAY0

Encoder mounting instructions:
https://www.cuidevices.com/amt-mounting

Github repo (Matlab files, CAD, STL, etc.):
https://github.com/oystebje/EGGDROP

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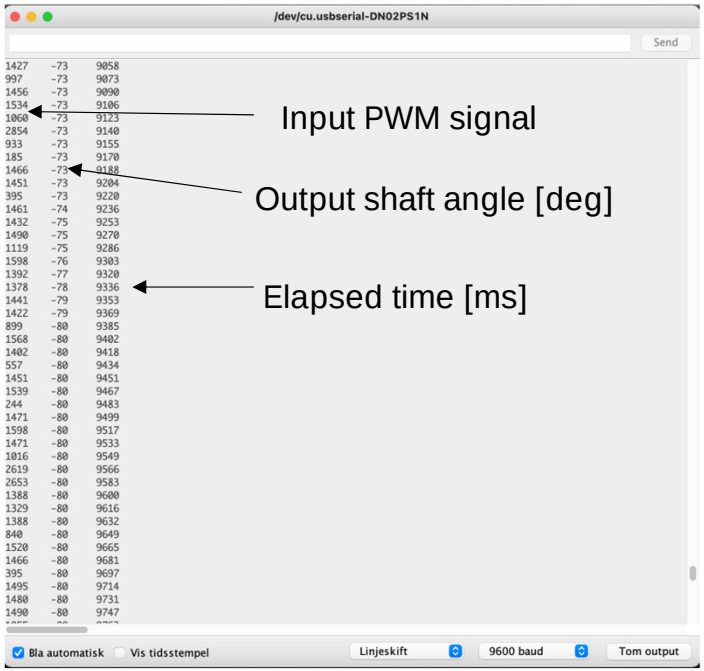
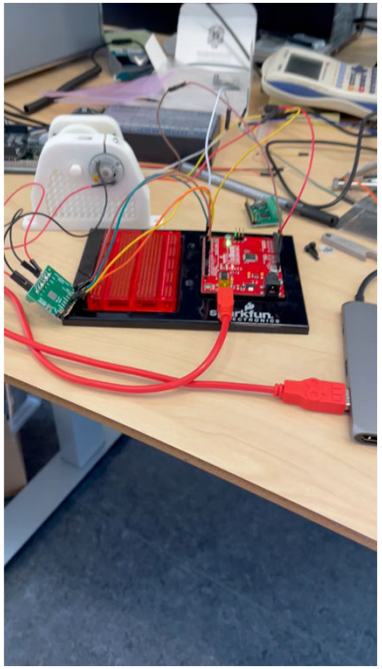
Data collection





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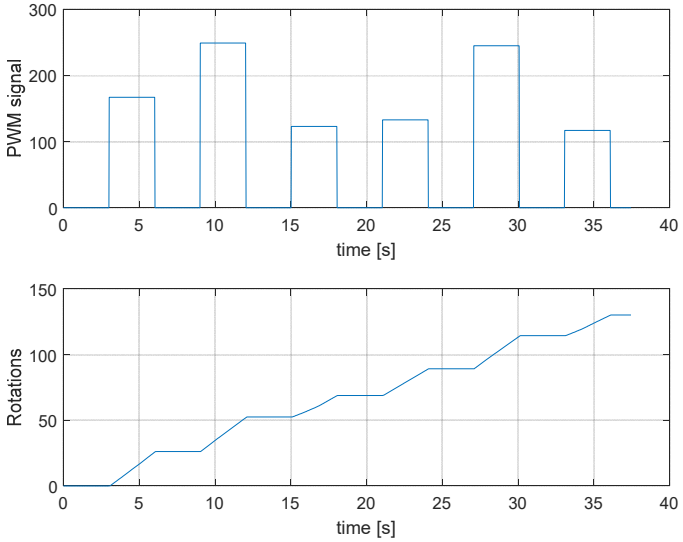
Project Description:
System Identification of DC Motor

You must set up experiments that replicate the egg drop competition!

Remember get good training AND validation data.



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