CSE 4360: Homework 2

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Solve for $\tau = I\ddot{\theta} + B\dot{\theta} + G(\theta)$

Experiment 1 - Solving for Gravity:

- Set $\ddot{\theta} = 0$ and eventually $\dot{\theta} = 0$.
- Steps to reproduce:
  1. Set a static double prevDelta to zero.
  2. Set prevDelta = prevDelta - theta_dot
  3. return (prevDelta)
- Basically since the arm starts at $\theta \approx 0$, we can provide the acceleration in the opposite direction to keep the arm still.
- print the angle, angular velocity and prevDelta. once velocity stabilizes, we will know G at $\theta = 0$.

Value found = 1.175997

From Terminal:
Angle = -0.002352
Angular Velocity = -0.000000
G(0) = 1.175997

Experiment 2 - Solve for friction (B):

- Apply constant force and find b when the velocity is constant (acceleration is zero), also need to compensate for gravity.

$$\tau + G\sin(\theta) = 0 + B(\dot{\theta})$$

Procedure:
1. Wait for system to zero out.
2. Apply force until velocity is constant, we can then divide the force by that velocity.
3. Use a large number for τ so that gravity has less of an effect.

Value found for B = .1 @ f=5000, $\dot{\theta}$ = 50000

Experiment 3 - Solve for inertia (I):

- Apply constant acceleration, compensating for friction and gravity. Divide that force by the acceleration.

Procedure:

1. Return a constant force + $g(\theta) + b\dot{\theta}$
2. Once acceleration is constant, ie velocity increasing at the same rate, divide force by the acceleration.
3. $\tau = f + g(\theta) + b\dot{\theta}$

   $f = 5000$, g - constant $\cdot \sin(\theta) + b\dot{\theta}$
4. Sum changes in velocity for 500 calls (ie 1 sec) then divide force by it.

Results:

$$I = 0.036$$

$$\tau = 0.036(\ddot{\theta}) + .1(\dot{\theta}) + 1.176(\theta)$$

*Note I also got 18.2 consistently if I used the acceleration between calls. I decided it would be best to keep the units the same. So I stayed with .036.