Homework 1

Simulation of Motor without Added Inertia or Friction

Parameter Lookup

1. Motor no-load speed at 12 VDC

$$\omega_{\text{No Load}} = 5600\ rpm \approx 586.431\ rad/sec$$

2. Motor stall torque at 12 VDC

$$\tau_{\text{stall}} = 2\ oz \cdot in \approx 0.01412\ Nm$$

Summary of Equations and Assumptions

Assumptions

1. No added inertia
2. No added friction
3. Motor runs at full 12 VDC
4. No loss of power

Governing Equations

$$\mathrm{T} = \frac{\mathrm{K}}{\mathrm{R}} V(t) - \frac{K^2}{R}\omega(t)$$

$$\mathrm{K} = \frac{\mathrm{V}}{\omega_{no\ load}}$$

$$\mathrm{R} = \frac{\mathrm{KV}}{T_{stall}} = \frac{V^2}{\omega_{no\ load} T_{stall}}$$

$$\mathrm{T} = \mathrm{I}\alpha \quad , \quad \alpha = \dot{\omega} = \ddot{\theta}$$

MATLAB Code and Plots

MATLAB Code

```
%%156A Fall 2016 Homework 1
%Assumptions from motor primer
clear all
clc
w_no_load = 586.431; %[rad/s] converted from 5600 rpm

T_stall = 0.01412; %[N-m] converted from 2 oz-in

V = 12; %[V] voltage of power supply
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```
K_v = V/w_no_load;%[V*s/m]

R = K_v*V/T_stall;%Ohm

C1 = K_v^2/R; %

I = 5.15*10^(-7); % estimate of inertia [kg*m^2]

t_step = .00001; %time step
n = 0.200/t_step; %changes  parameters based on step size

%initial conditions
%Initial position = 0
%Initial velocity = 0
t = zeros(1,n); %initialize the time vector
pos = zeros(1,n);%initialize position vector
w = zeros(1,n); %initialize angular velocity vector
a = zeros(1,n); %initialize acceleration vector
for i = 1:n
    t(i+1) = t(i) + t_step; %increments time
    pos(i+1) = pos(i) + w(i)*t_step; %estimate of position
    a(i) = -C1/I*(w(i) -w_no_load); %estimate of acceleration
    w(i+1) = w(i) + a(i)*t_step; %estimate of angular velocity

end
%Opens figure and plots velocity in [deg/s] vs time in [ms]
figure(1);
plot(1000*t,w*180/pi), xlabel('time [ms]'),ylabel('Angular Velocity [deg/s]'),
title('Velocity vs Time');
%Opens figure and plots position in [deg] vs time in [ms]
figure(2);
plot(1000*t,pos*180/pi), xlabel('time [ms]'),ylabel('position [deg]'), title('Position
vs Time') ;
```

Plots