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ESE 4481 Homework 3

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```
clear, clc, close all
```

Constant Declaration:

```
m = 0.068;
Jxx = 0.69e-4;
Jyy = 0.775e-4;
Jzz = 1.5e-4;
g = 9.8;
motor_num = 4;

J = [Jxx 0 0; 0 Jyy 0; 0 0 Jzz];

F_b = zeros;
M_b = zeros;

x_dist = 0.047625; % prop to com x distance
y_dist = 0.047625; % prop to com y distance, in meters

prop_mass = 0.001; % in kg
prop_diam = 0.066; % meters
max_rpm = 29000; % rpm
max_rev = max_rpm/60;

air_density = 1.225; % kg/m^3
c_p = 0.041; % power coefficient, assume flat, constant coeff of power
```

Curve fit estimating thrust coefficient

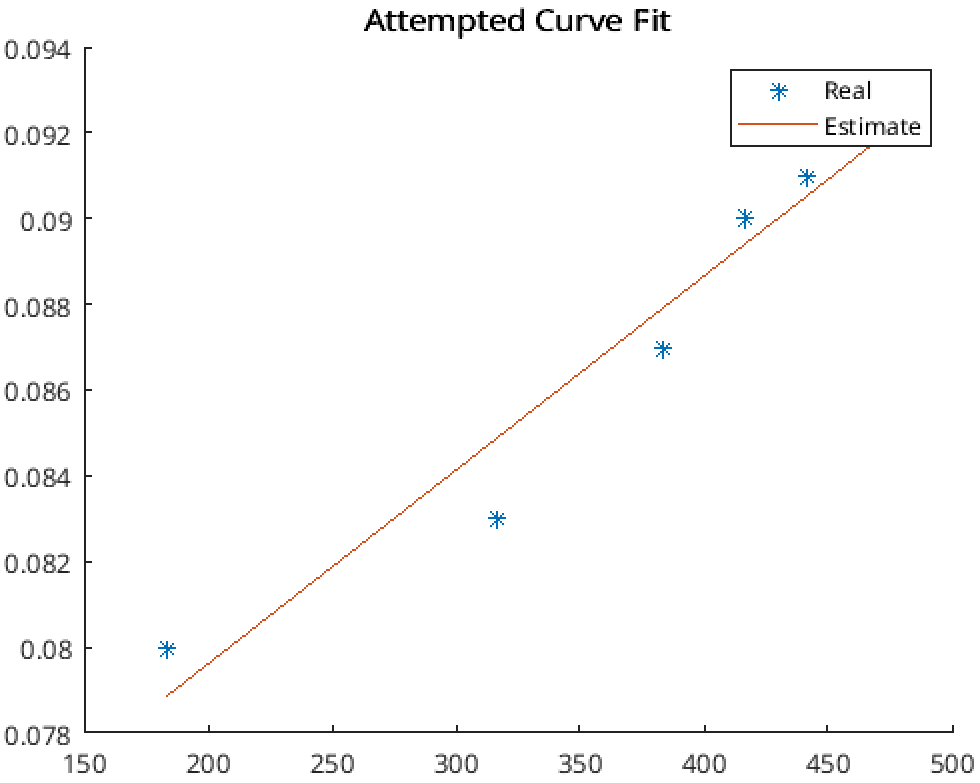
```
rev = [11000 19000 23000 25000 26500 29000]'/60;
c_t = [0.08 0.083 0.087 0.09 0.091 0.093]';

% regressor matrix
regressor = cat(2, ones(size(rev)), rev);
```

```
k_estimate = (regressor' * regressor) \ regressor' * c_t;
offset = k_estimate(1);
slope = k_estimate(2);

residual = norm(c_t - regressor*k_estimate);
residual_cons = norm(c_t - 0.087*ones(size(c_t)));

% examine error
figure, hold on;
plot(rev, c_t, '*');
plot(rev, regressor*k_estimate);
legend('Real', 'Estimate');
title('Attempted Curve Fit');
```



Equilibrium Motor Speed, prop moment of inertia

```
thrust_eq = @(x) m*g/motor_num - (slope*x+offset)*air_density*x^2*...
    prop_diam^4;

motor_n_eq = fzero(@(x) thrust_eq(x), 300);
motor_omega_eq = motor_n_eq * 2 * pi;

% assuming a spinning cylinder about mid point
prop_j = 1/12*prop_mass*prop_diam^2;
```

Mixer Parameters

```
% sums the motor speeds into T, L, M, N
dynamics_matrix = [1 1 1 1;
                1 -1 -1 1;
                1 1 -1 -1;
                -1 1 -1 1];

mixer_matrix = inv(dynamics_matrix);
```

Lumped aerodynamics model

```
K_c = 0.22;
lumped_matrix = [K_c 0 0; 0 K_c 0; 0 0 0];
```

Gyroscopic forces and moments

```
motor_mix_vector = [1 -1 1 -1];
m_b_a = [0;0;0];
```

Process Simulation

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