Table of Contents


```
function [power, powerReserve, maxV] = PowerRequiredQ4(V, height, plotVal)

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%%%%%%%%%
% Author: Hudson Reynolds, Preston Wright
% Description: function that finds power for prop aircraft based on the
% velocity
%
% Inputs:
% V - velocity [m/s]
%
% Outputs:
% thrust - the required thrust to maintain SLUF conditions [N]
% thrustReserve - the percentage of thrust remaining [N]
% plots - see outputs
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%%%%%%%%%

% included so script doesn't throw errors when publishing. Delete these to
% run it as a function
height = 4618.0248;
V = 50:1:175;
plotVal = 0;
```

Constants:

```
[~, ~, ~, rho0] = atmosisa(0);      % density of air at sea level [kg/m^3]
[~, ~, ~, rho] = atmosisa(height); % density of air [kg/m^3]
A = 39.4;                           %wing area [m^2]
b = 19.78;                          %wing length [m]
W = 10500;                          % weight [kg]
cD0 = 0.021;                        % zero AoA cD
p0max = 1342.26 * 2 * 1000;         % sea level power [W]
eta = 0.8;                          % propeller efficiency
e = 0.7;                            % oswald efficiency
AR = b^2 / A;                       % wing aspect ratio
```

Calculations:

```
cDa = 1 / (pi * e * AR);  % induced drag coefficient

% perform power calculations:
```

```
power = 1/2 * rho * A * V.^3 * cD0 + 2 * (W * 9.81)^2 ./ (e * AR * pi * rho
* A * V);

powerMax = eta * (rho / rho0)^0.6 * p0max;

powerReserve = 1 - (power / powerMax);

% find the power closest to the max power and the corresponding velocity:
[~, minIndex] = min(abs(power - powerMax));

maxV = V(minIndex);

% solve symbolically to check:

syms x

eqn = powerMax == 1/2 * rho * A * x^3 * cD0 + 2 * (W * 9.81)^2 / (e * AR *
pi * rho * A * x);

sol = solve(eqn, x, real=true);

fprintf("%.2f\n %.2f\n", sol(1), sol(2))
```

```
19.86
 165.05
```

Plots

```
if plotVal == 1
    close all

    hfig = figure;  % save the figure handle in a variable
    fname = 'Power v Velocity Graph Q4';

    hold on

    plot(V, power / 1e3)
    yline(powerMax/ 1e3 ,'r--')
    title("Velocity v. Power at 15,151 ft")
    xlabel("Velocity [m/s]")
    ylabel("Power [kW]")




    picturewidth = 20; % set the width of image in cm
    hw_ratio = .6; % aspect ratio
    set(findall(hfig,'-property','FontSize'),'FontSize',16) % adjust font
size

    legend('Power Required', 'Max Power', 'FontSize', 12, 'location',
'northwest')
```

```
    grid on

    set(findall(hfig,'-property','Box'),'Box','off') % turn off box
    set(findall(hfig,'-property','Interpreter'),'Interpreter','latex')
    set(findall(hfig,'-
property','TickLabelInterpreter'),'TickLabelInterpreter','latex')

    set(hfig,'Units','centimeters','Position',[3 3 picturewidth
hw_ratio*picturewidth])
    pos = get(hfig,'Position');

set(hfig,'PaperPositionMode','Auto','PaperUnits','centimeters','PaperSize',
[pos(3), pos(4)])
    %print(hfig,fname,'-dpdf','-vector','-fillpage')

    print(hfig,fname,'-dpng','-r300')
end


ans =

   1.0e+06 *

  Columns 1 through 7

    0.6827    0.6726    0.6630    0.6539    0.6454    0.6374    0.6299

  Columns 8 through 14

    0.6229    0.6163    0.6102    0.6044    0.5991    0.5942    0.5897

  Columns 15 through 21

    0.5856    0.5818    0.5784    0.5753    0.5726    0.5702    0.5682

  Columns 22 through 28

    0.5664    0.5650    0.5639    0.5631    0.5626    0.5624    0.5625

  Columns 29 through 35

    0.5628    0.5635    0.5644    0.5656    0.5671    0.5688    0.5709

  Columns 36 through 42

    0.5732    0.5757    0.5785    0.5816    0.5850    0.5886    0.5925

  Columns 43 through 49

    0.5966    0.6010    0.6056    0.6105    0.6157    0.6211    0.6268

  Columns 50 through 56
```

```
  0.6327    0.6389    0.6453    0.6520    0.6589    0.6661    0.6736

Columns 57 through 63

  0.6813    0.6892    0.6975    0.7059    0.7147    0.7237    0.7329

Columns 64 through 70

  0.7424    0.7522    0.7622    0.7725    0.7830    0.7939    0.8049

Columns 71 through 77

  0.8163    0.8279    0.8398    0.8519    0.8643    0.8770    0.8899

Columns 78 through 84

  0.9032    0.9167    0.9304    0.9445    0.9588    0.9734    0.9883

Columns 85 through 91

  1.0035    1.0189    1.0346    1.0506    1.0669    1.0835    1.1004

Columns 92 through 98

  1.1176    1.1350    1.1528    1.1708    1.1891    1.2078    1.2267

Columns 99 through 105

  1.2459    1.2655    1.2853    1.3055    1.3259    1.3467    1.3677

Columns 106 through 112

  1.3891    1.4108    1.4328    1.4551    1.4777    1.5007    1.5240

Columns 113 through 119

  1.5476    1.5715    1.5957    1.6203    1.6452    1.6704    1.6960

Columns 120 through 126

  1.7219    1.7481    1.7747    1.8016    1.8288    1.8564    1.8844
```

Published with MATLAB® R2023b