

Kocaeli University Mechanical Engineering Dynamics Course

Project Homework-1

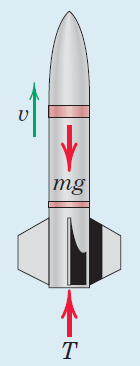
(Basic Rocket Dynamics Modelling)

EREN YAYLACI

200217029

In this project, I made the one-dimensional system model of the rocket by computation and tabulation in matlab.

The features of the rocket I used as a base in my project assignment are given below:



| Rocket Body Weight | 15 kg |
| --- | --- |
| Rocket Fuel Weight | 6 kg |
| Fuel Burn Speed | 2 kg/s |
| Thrust Weight Ratio | 2 |

Values are defined as follows:

Rocket\_W = 15; %kg

Fuel\_W = 6; %kg

Fuel\_Burn = 3; % kg/s

t\_W\_r = 2; %thrust weight ratio

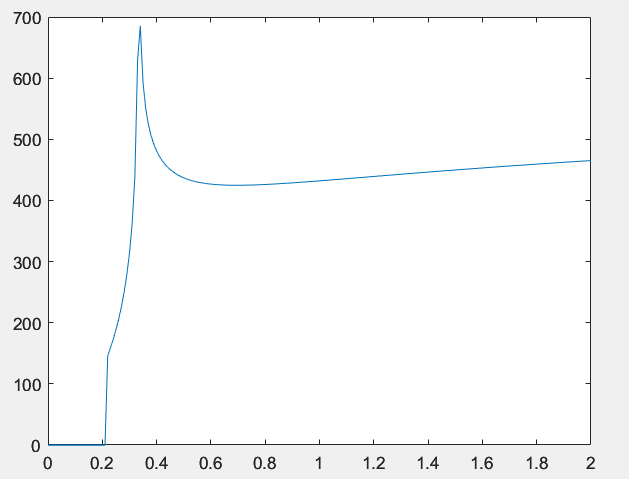
We can derive the critical value required for the rocket to take off with the following formula.(r = thrust weight ratio)

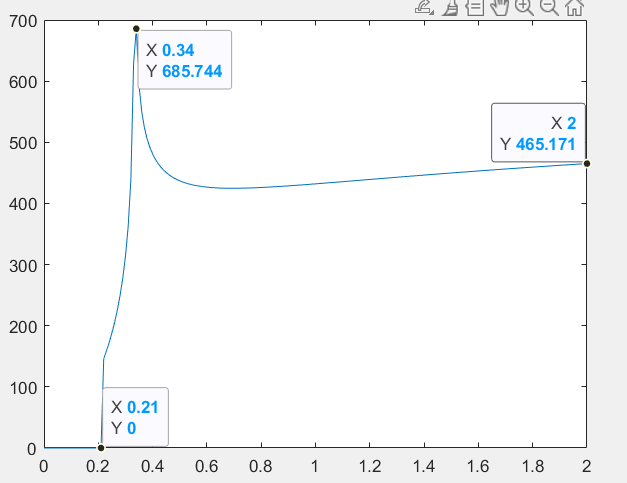
v\_e = (g\*Sum\_W\*t\_W\_r)/Fuel\_Burn; % m/s

We find the instantaneous velocity with the following relation.

v = v\_e\*(abs(ln(Sum\_W/Sum\_W\*(1-Fuel\_Burn\*t))))- g\*t;%m/s

With this data we have, we can plot the velocity time graph until the fuel runs out.





x-axes => time

y-axes => instantaneous velocity

Then I calculated the highest altitude and flight time of the rocket by using the law of conservation of mechanical energy using the speed the rocket achieved at the end of combustion.

| h(max) | 11,8092 km |
| --- | --- |
| flight time | 49,4180 s |

Matlab Code:

Rocket\_W = 15; %kg

Fuel\_W = 6; %kg

Fuel\_Burn = 3; % kg/s

g = 9.81; % m/s^2

Sum\_W = Rocket\_W + Fuel\_W;

time = Fuel\_W/Fuel\_Burn;%

v\_t = ones(time\*100,2);

t\_W\_r = 2; %thrust weight ratio

v\_e = (g\*Sum\_W\*t\_W\_r)/Fuel\_Burn; % m/s

S = 0;

s\_t = ones(time\*100,2);

i = 0;

k =0;

for t = 0:+0.01:time

i = i + 1;

Gravity\_Velocity = g\*t;

v = v\_e\*(abs(ln(Sum\_W/Sum\_W\*(1-Fuel\_Burn\*t))))- Gravity\_Velocity;

if v >= v\_e && k==0

disp("take off");

disp(i);

disp(v);

k = 1;

else

if k ~= 1

v = 0;

end

end

disp(t);

disp(v);

v\_t(i,:) = [t,v];

S = S + v/100;

disp(S)

s\_t(i,:) = [t,S/1000];

end

disp(S)

v\_s = v\_t(time\*100+1,2);

K\_E = (Rocket\_W\*(v\_s)^2)/2;

P\_E = Rocket\_W\*g\*S/1000;

time\_s = v\_s/g;

F\_time = time + time\_s;

h = (K\_E/(Rocket\_W\*g)+S)/1000;

plot(v\_t(:,1),v\_t(:,2));