P. 2

Problem Statement

differential equation for a bungee jumper depend on whether jumper has fallen to a distance where cord is fully extended and begin to streach. condition of spring and dampening ~~force~~ forces is encuded in following equation Using Fourth order Runga-kutta method impliment computation from $t = 0s$ to $t = 50s$

Given,

$L = 30$

$m = 68.1$

$C_d = 0.25$

$k = 40$

$\gamma = 8$

$\text{sign}(x) \Rightarrow -1, 0, 1$

v is velocity

t is time

$g = 9.81$

equation,

$$\frac{dv}{dt} = \begin{cases} g - \text{sign}(v)\dfrac{C_d}{m}v^2 & ; x \leq L \\ g - \text{Sign}(v)\dfrac{C_d}{m}v^2 - \dfrac{k}{m}(x-L) - \dfrac{\gamma}{m}v & ; x > L \end{cases}$$

initization,

$x(0) = v(0) = 0$

$$\text{Sig}(v) = \begin{bmatrix} -1 & v < 0 \\ 0 & v = 0 \\ 1 & v > 0 \end{bmatrix}$$

Applying Runga - kutta fourth order,

$h = 0.1$ — step size assumed

$t \Rightarrow (0 \text{ to } 50)$ — given,

$x_{i+1} = x_i + Qh.$

$x_{i+1} = x_i + v_i h$

$Y_{i+1} = Y_i + \frac{1}{6}(k_1 + 2k_2 + 2k_3 + k_4)h.$

where, $k_1 = f(x_i, y_i)$

$k_2 = f(x_i + h/2, \; y_i + k_1 h/2)$

$k_3 = f(x_i + h/2, \; y_i + k_2 h/2)$

$k_4 = f(x_i + h, \; y_i + k_3 h)$

So after code our final value for step size 0.1 is

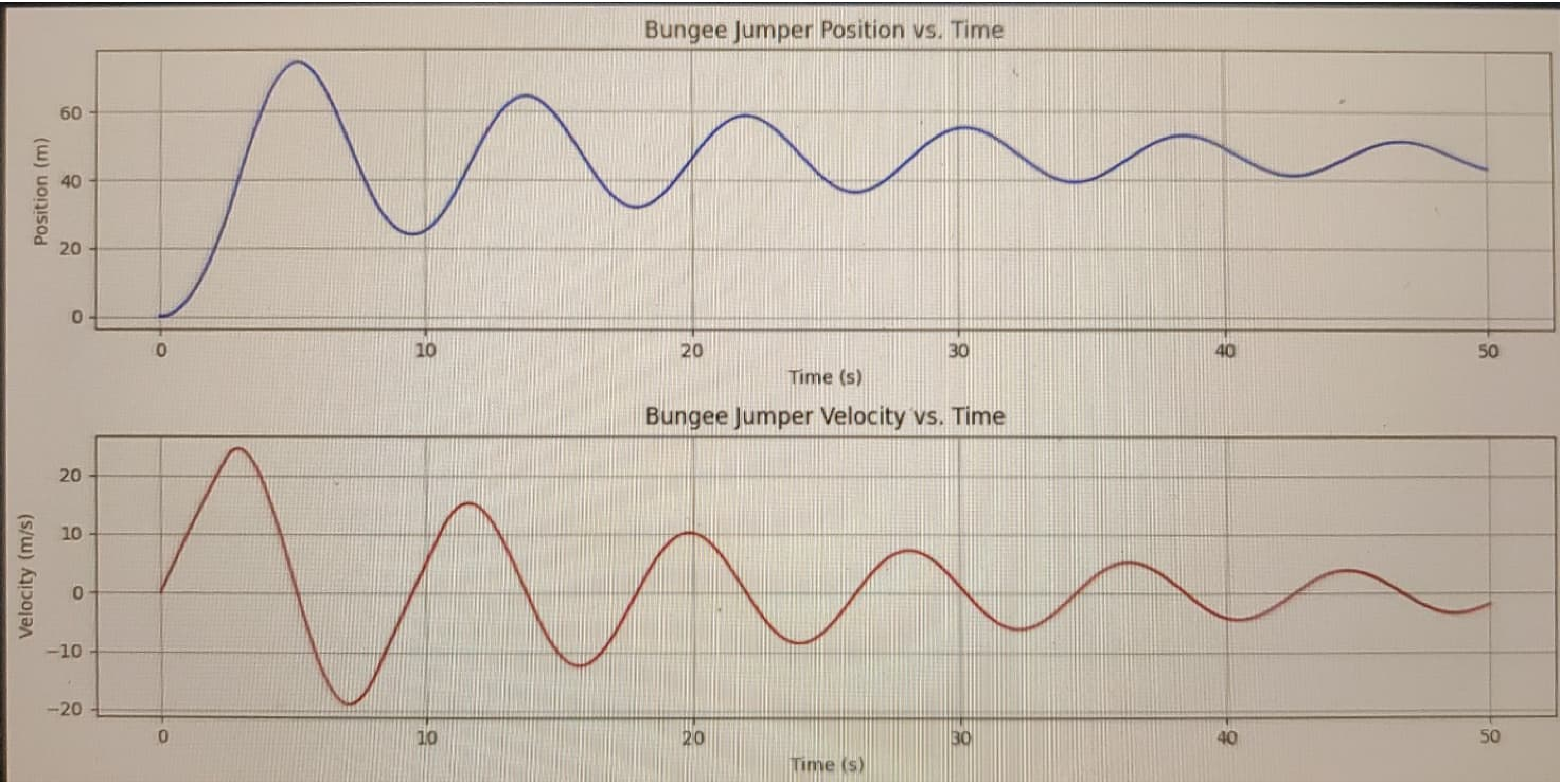
final time = 50's,

final Position = 43.35 m,

final Velocity = -1.76 m/s.

Note : value will change if step size change

step - size $\downarrow$ & accuracy $\uparrow$


Bungee Jumper Position vs. Time
Position (m)
0
20
40
60
0
10
20
30
40
50
Time (s)
Bungee Jumper Velocity vs. Time
Velocity (m/s)
−20
−10
0
10
20
0
10
20
30
40
50
Time (s)