Anyoha Valentine
16/ENG06/014
Mechanical Engineering
ENG 382

A plate (flat) of mass m falling freely in air with velocity (v) is subject to a downward gravitational force, F_D is given by eqn (1)

$$F_D = \frac{0.3v^2}{500 + (\ln v)^3} - 0.02v \quad \text{---(1)}$$

and the terminal velocity is reached when the drag force equals the gravitational force, that is; $F_D = Mg$ --- (2) taking the values of m and g to be 3.5kg and $9.8 m/s^2$ respectively, using a guess value of $V_0 = 0.5 m/s$ & employing fixed-point iteration method, develop a MATLAB Program to estimate the terminal velocity. Take the absolute percentage relative error tolerance to be less than or equal of $1E-1$

Soln

$$F_D = \frac{0.3v^2}{500 + (\ln v)^3} - 0.02v \quad \text{---(1)}$$

$$F_D = Mg = 3.5 \times 9.8 = 34.3 \quad \text{---(2)}$$

evaluating eqn 1 & 2

$$mg = 34.3 = \frac{0.3v^2}{500 + (\ln v)^3} - 0.02v$$

Make v^2 subject of formular

$$34.3 + 0.02v = \frac{0.3v^2}{500 + (\ln v)^3}$$

$$0.3v^2 = (34.3 + 0.02v) * (500 + (\ln v)^3)$$

$$V^2 = [(34.3 + 0.02v) * (500 + (\ln v)^3)]/0.3$$

$$V = \sqrt{[(34.3 + 0.02v) \times (500 + (\ln v)^3)]/0.3}$$

Initial guess value $\Rightarrow V_0 = 0.5 m/s$

Absolute % relative error, $\varepsilon_a(i+1) \leq 1E$

MATLAB

```
1 - Command window
2 - Clear
3 - Clc
4 - Close all
5 - format short g
6 - syms V
7 - v = 0.5
8 - for i = 1 : inf
9 -   iter (i+1) = i;
10 -  v(i+1) = [(34.3 + (0.02 * v(i)) * (500 + (log (v(i)))] ^ 3) / 0.3^0.5;
11 -  Ea(i+1) = abs ((v(i+1) - v(i)) / v(i+1)) * 100;
12 -    if Ea (i+1) <= 1E--11
13 -      break
14 -    end
15 -  end
      table = [iter' v' Ea']
```

The estimated terminal velocity is 304.07 m/s.

Substituting in eqn (1) $F_D = 34.3$.