

key physics & mechanics involved

1.1 Force of Bowstring

→ Hooke's Law

$F = -kx$ where $k \rightarrow$ spring constant
 $x \rightarrow$ Displacement of string from rest
 $F \rightarrow$ force applied by string

1.2. Projective Motion

$$x(t) = v_x \cdot t$$

$$y(t) = v_y \cdot t - \frac{1}{2}gt^2$$

where, $v_x = v \cos \theta$ (horizontal velocity)
 $v_y = v \sin \theta$ (vertical velocity)
 $g = 9.8 \text{ m/s}^2$ constant

1.3 Air Drag

→ $F_d = \frac{1}{2} \rho C_d A v^2$ where ρ : air density
 C_d : drag coefficient
 A : cross sectional area

Position updates

→ As follows iteratively

$$x(t) = x_0 + v_x \cdot t, \quad y(t) = y_0 + v_y \cdot t - \frac{1}{2}gt^2$$

Accounting for gravity: $v_y = v_y - g \cdot \Delta t$

Breakpoint: $y \leq 0$ when arrow hits ground

FBD:

