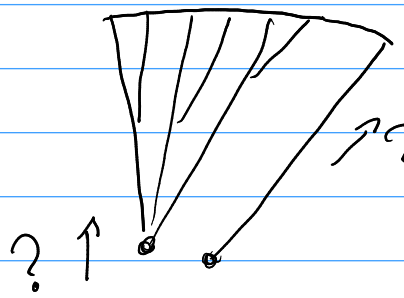
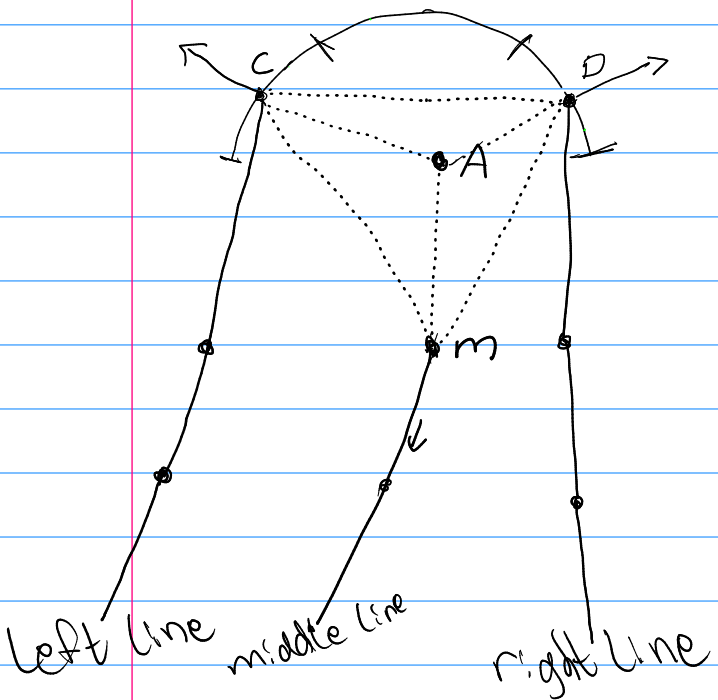
force on left wire is difficult to model

can assume Lift is divided between power and steering Lines with a constant



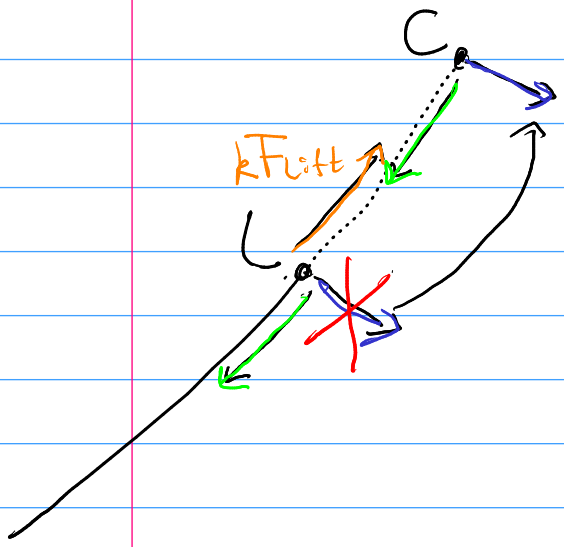


$DD' = k \cdot m, m_1'$

(motor, left, right)

m, L, r are all on the same line of the last m segment (L and r are connected to m after the right distance is calculated

steering tether connection



$$F_L = F_g + F_d + F_{tether} + k \cdot F_{Lift,-z}$$

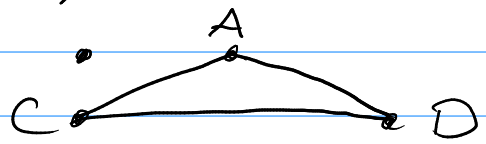
$$F_C = F_L - F_L$$

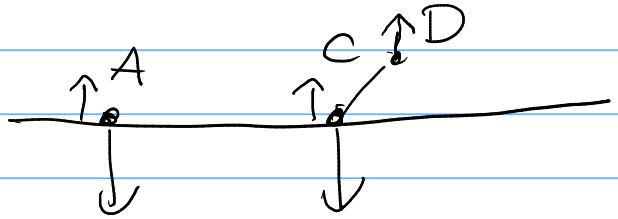
$$resI = norm(v_C - v_L)$$

$\Rightarrow$ L should never move relative to C

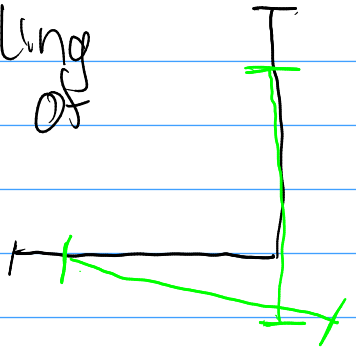
$$res2 = norm(a_C - a_L)$$

improvement: divide F_{tether} over A, C and D



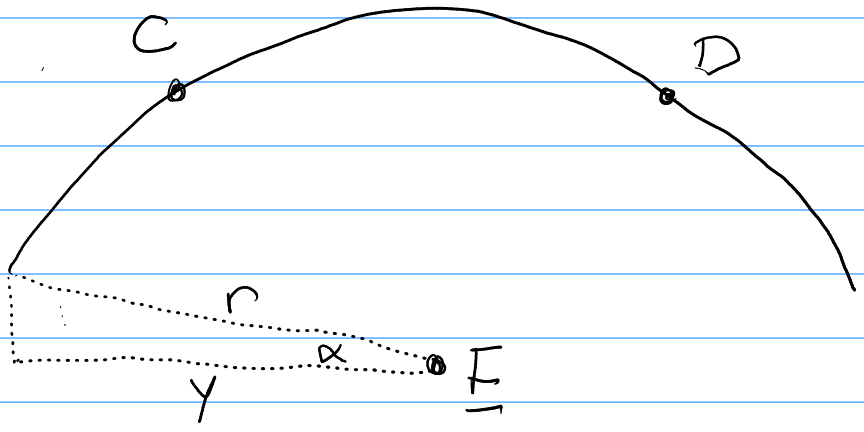


movement of trailing edge ≈ movement of L or r

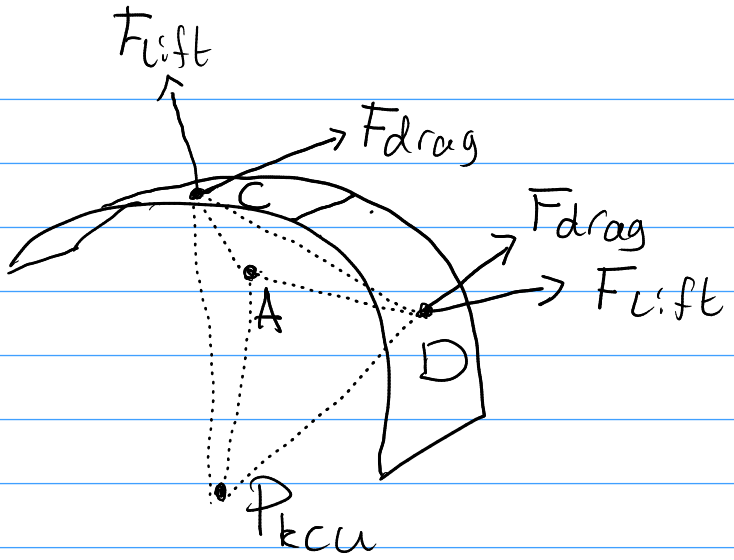


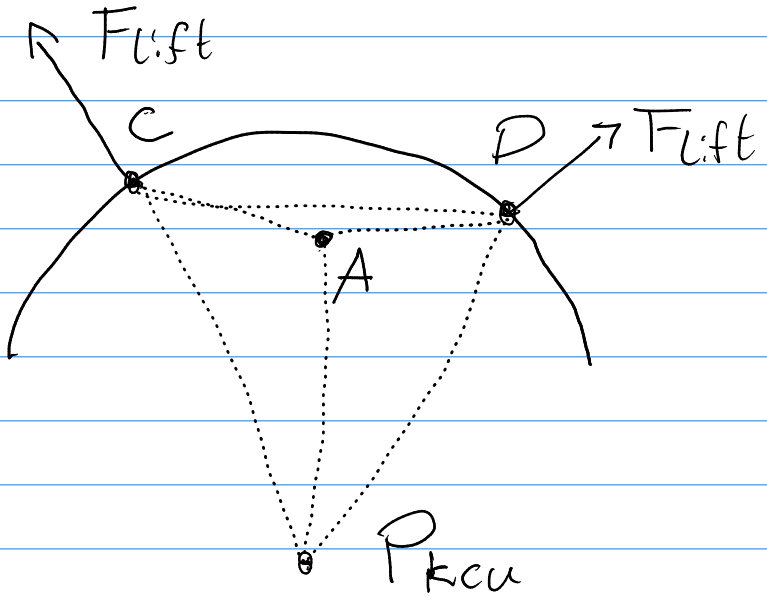
want to have Lift dependent of this distance, not angle

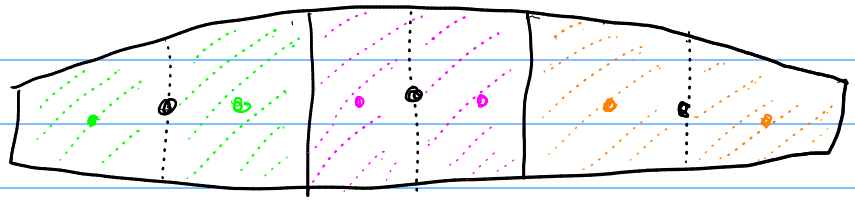
to find drag coefficients:
1 test kite and measure angles
2 manually change coefficients until they are right in sim



remove point B

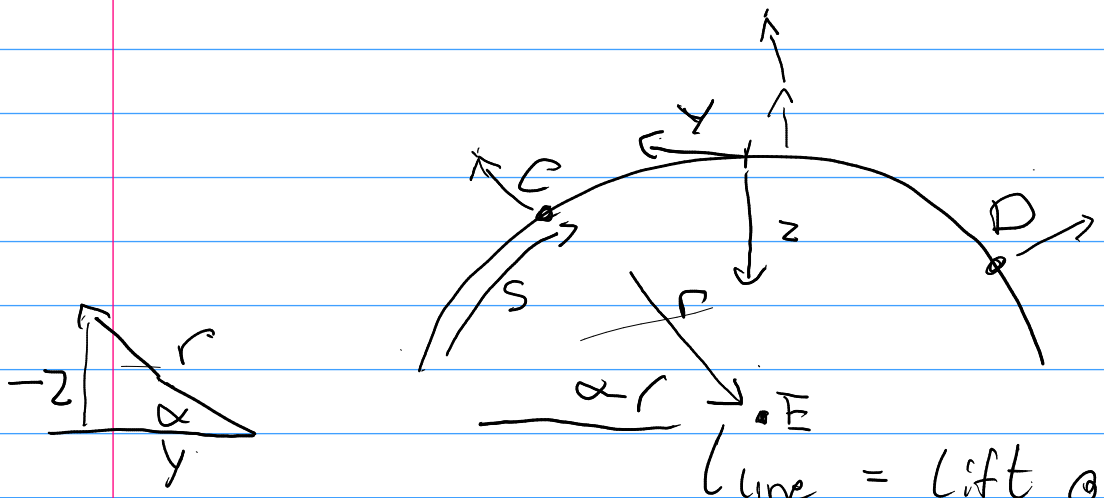






- mass
- force
- force on mass = Σ force

should work as long as the dyhedral is not accounted for?

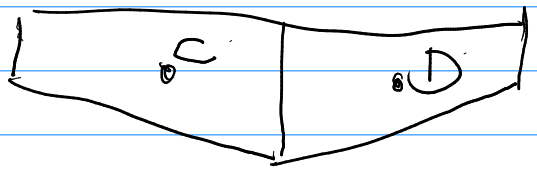


L_{line} = Lift on a line with length m

$$L_{c,x} = \int_0^{\frac{1}{2}w} L_{Lines} \cdot ds$$

$$L_c = \begin{bmatrix} L_{c,z} \\ L_{c,y} \end{bmatrix}$$

$$L_{Line} = \frac{1}{2} \rho V$$

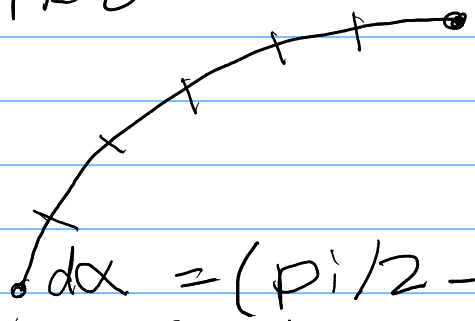


$\leftarrow Y$ $\rightarrow s$ = Spine length

$X \downarrow$

$$M = \frac{C+D}{2}$$

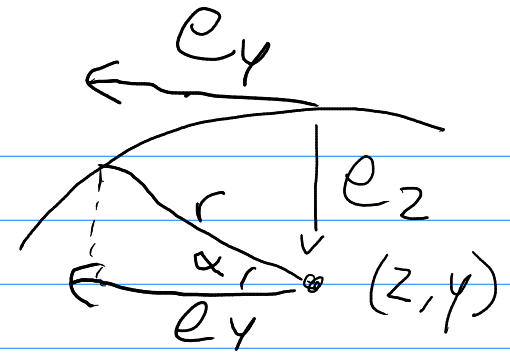
$n = 6$



$$d\alpha = (pi/2 - a_0)/n$$

$$L = \sum_{i=0}^{n} \frac{dL}{d\alpha} (d\alpha/2 + d\alpha \cdot i + \alpha_0) \cdot d\alpha$$

$$L_c = \int_{\alpha_0}^{\frac{1}{2}\pi} \frac{dL}{d\alpha} d\alpha$$



$$L = \frac{1}{2}\rho v_{a,xr}^2 A\, C_L(\alpha_c) \cdot e_r$$

$$e_r = \frac{E - F}{\|E - C\|}$$

$$F = E + e_y \cos\alpha\, r - e_z \sin\alpha\, r$$

F is any point on the kite

$$v_a = v_{wind} - v_{kite}(\alpha)$$

$$v_{kite}(\alpha) = \begin{bmatrix} v_{ex} \\ v_{ey} \\ v_{ez} \end{bmatrix}' \cdot [e_x\ e_y\ e_z]$$

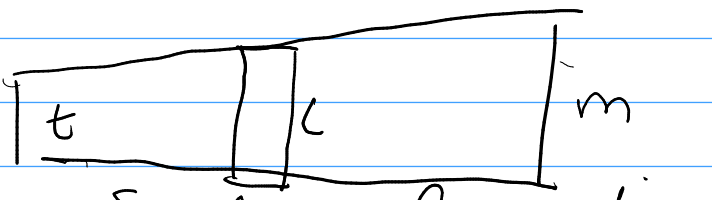
$$= \begin{bmatrix} \frac{v_{Cx} - v_{Dx}}{y_C - y_D} \cdot (y - y_D) + v_{Dx} \\ v_{Ey} \\ v_{Ez} \end{bmatrix}' [e_x\ e_y\ e_z]$$

$v_{ex} = v_e \cdot e_x$

$$y = \cos\alpha\, r$$
$$z = \sin\alpha\, r$$

$$= \begin{bmatrix} \frac{v_{Cx} - v_{Dx}}{y_C - y_D} (\cos\alpha\, r - y_D) + v_D \\ v_{Ey} \\ v_{Ez} \end{bmatrix}' [e_x\ e_y\ e_z]$$

$$l = \left(t + \frac{m - t}{0{,}5w}\, s\right)$$



$$L(\alpha) = \frac{1}{2}\rho v_{a,xr}^2 S\left(t + \frac{m - t}{0{,}5w}\, s\right) C_L(\alpha)\, e_r$$

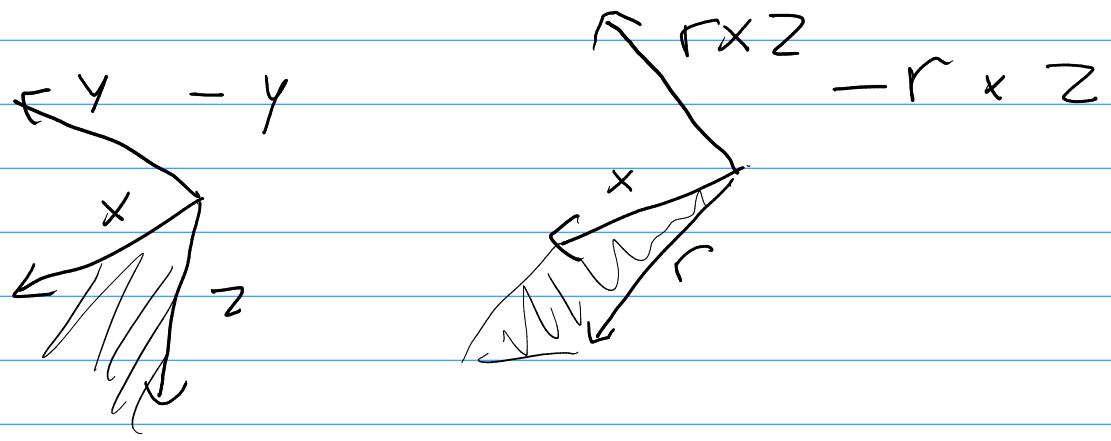
$$s = \alpha\, r$$

$$dL(\alpha) = \frac{1}{2}\rho v_{a,xr_1}^2 \left(t + \frac{m - t}{0{,}5w}\, \alpha\, r\right) C_L(\alpha) \cdot e_r$$

$$d\alpha\, r$$

$$\frac{dL}{d\alpha} = \frac{1}{2}\rho v_{a,xr}^2\, r \left(t + \frac{m - t}{0{,}5w}\, \alpha\, r\right) C_L(\alpha) \cdot e_r$$

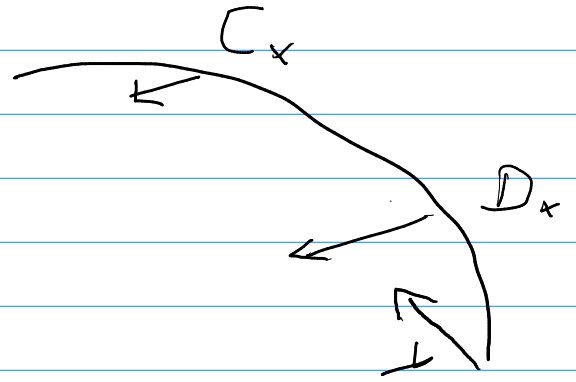
$$V_{a,xr} = V_a - (V_a \cdot (e_r \times e_x))(e_r \times e_x)$$



$$V_a = V_{wind} - V_{kite}$$

$$V_{Cx} = (V_C \cdot e_x) e_x$$

$$V_{kite}(\alpha) = V_x + V_y + V_z$$

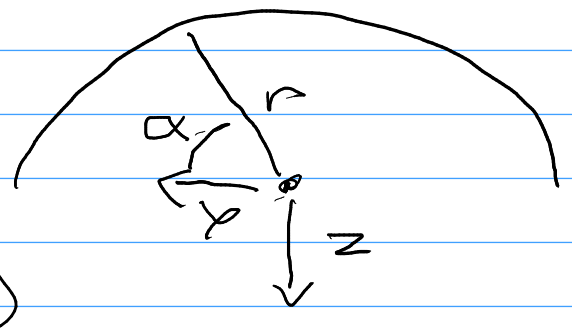


Local: $y_L = \cos\alpha \; r$

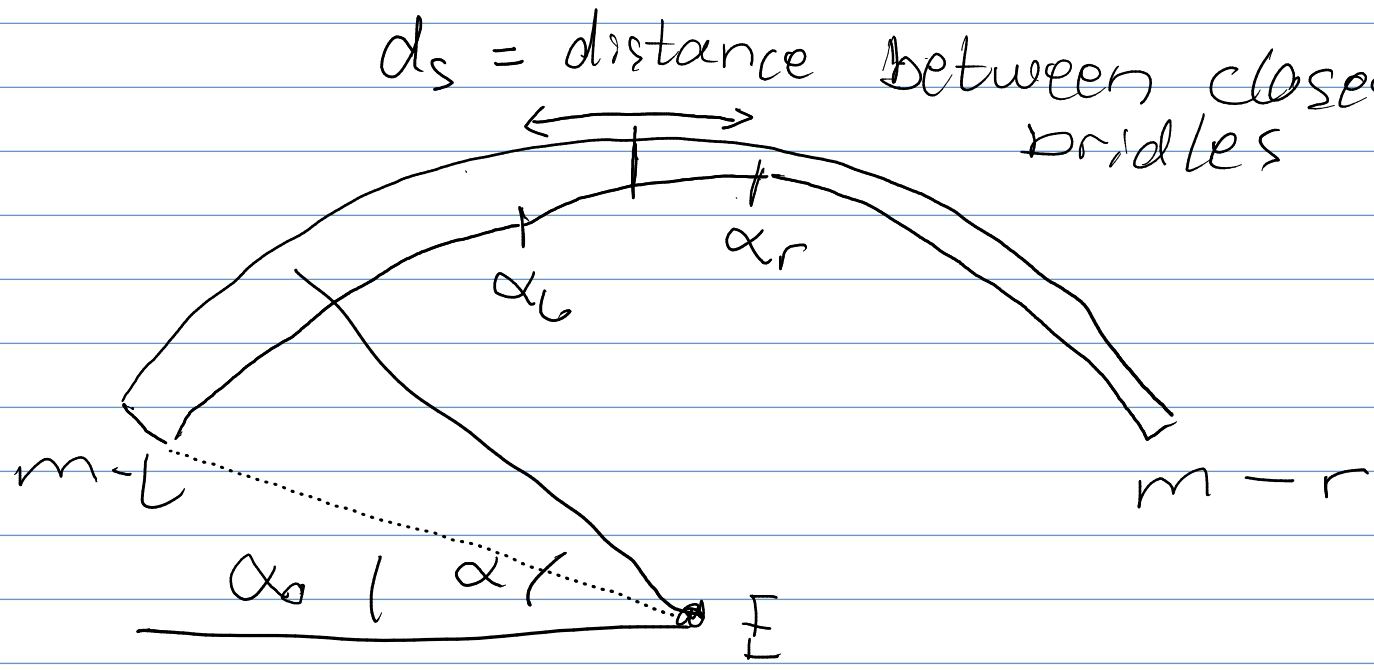
$z_L = \sin\alpha \; r$

$$y_{L,C} = \text{norm}(C - P)$$

$$y_{L,D} = -\text{norm}(D - P)$$



$$V_{kite}(\alpha) = \frac{V_{Cx} - V_{Dx}}{y_C - y_D}(y_L - y_{LD}) + V_{Dx} + V_{Ey} + V_{Ez}$$



c_l is dependent of trailing edge displacement d
m, l, r middle left right line length

$$\alpha_0 = (\pi - w/r)/2$$

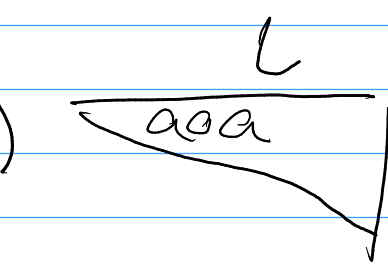
$$d(\alpha) = \begin{cases} m-l & \text{if } \alpha < \alpha_l \\ m-r & \text{if } \alpha > \alpha_r \\ \frac{(m-r)-(m-l)}{\alpha_r - \alpha_l}(\alpha - \alpha_l) + (m-l) & \text{if } \alpha_l < \alpha < \alpha_r \end{cases}$$

$$\alpha_l = \frac{1}{2}\pi - d_s/(2r)$$

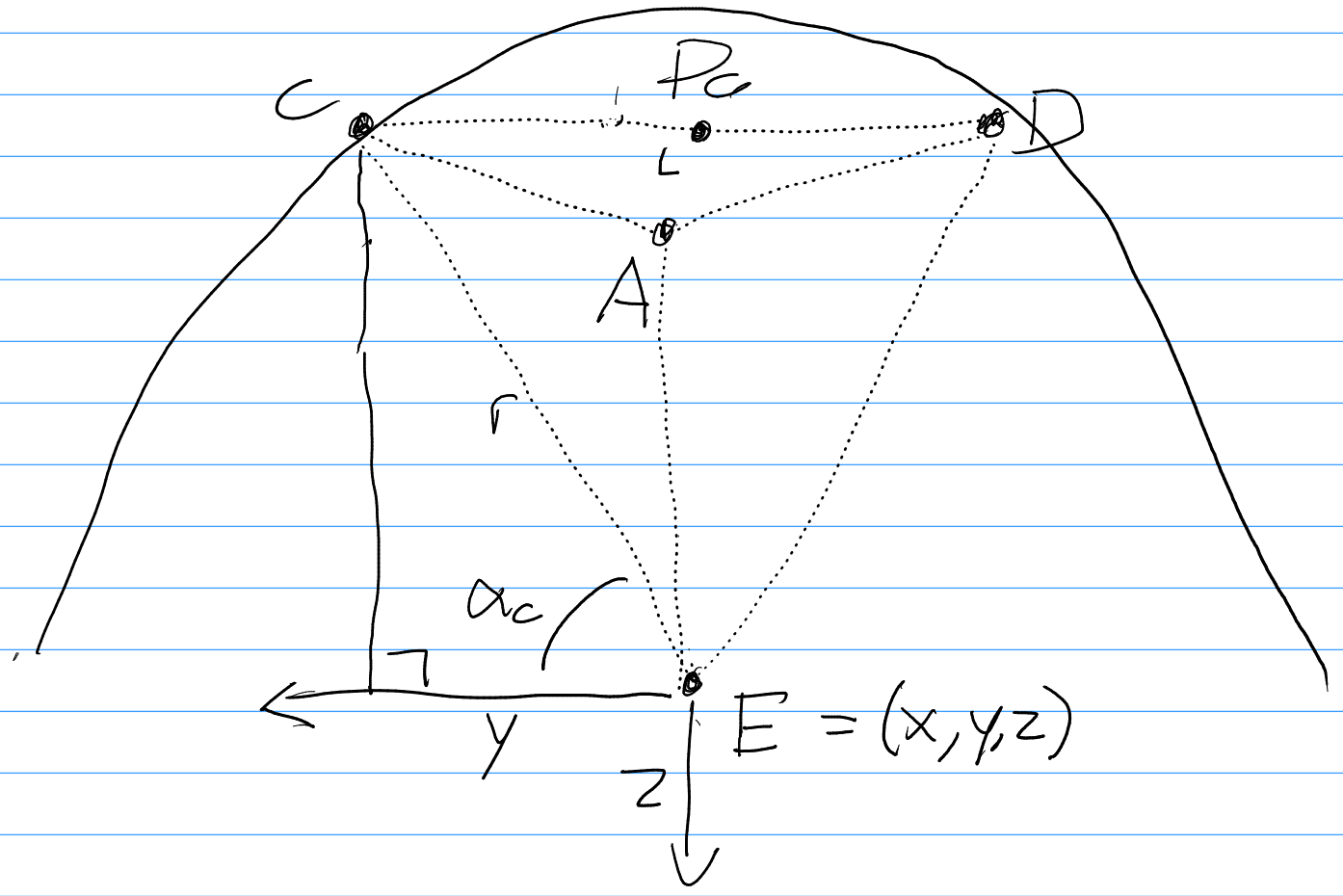
$$\alpha_r = \frac{1}{2}\pi + d_s/(2r)$$

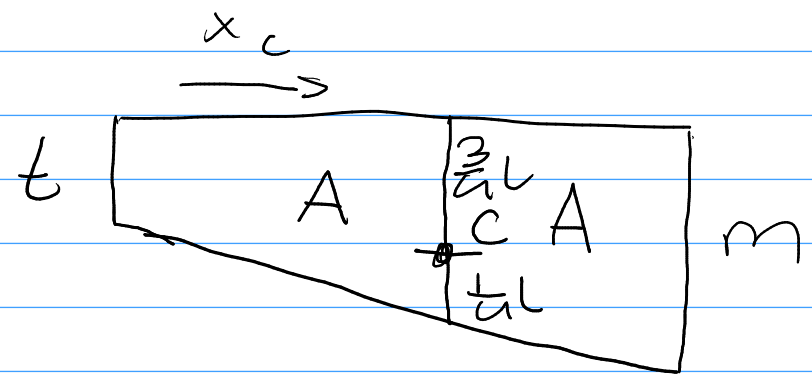
$c_l(aoa)$ where aoa is the angle of attack

$$aoa(d) = \tan^{-1}\left(\frac{d}{L}\right)$$



$$aoa(v_{xr}) = \pi - \arccos(\text{normalize}(v_{ca,xr}) \cdot x)$$





$A = A$ (areas are equal)

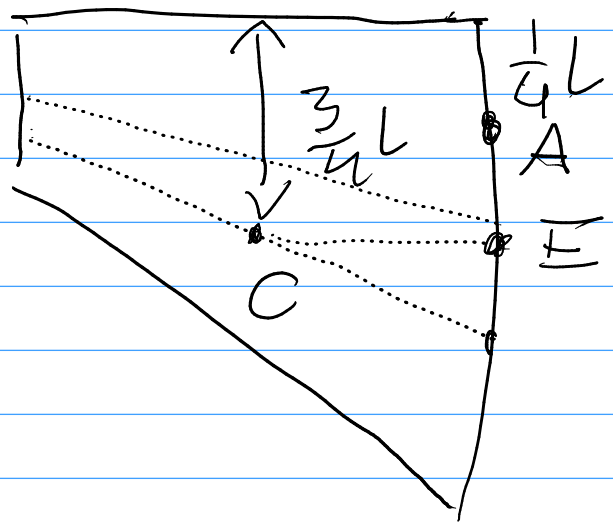
$$\frac{(L(\alpha_0) + L(\alpha_0))}{2}(\alpha_c - \alpha_0) =$$

$$\frac{(L(\alpha_c) + \frac{1}{2}\pi r)}{2}(\frac{1}{2}\pi - \alpha_c)$$

$$x_c = \frac{w(-2t + \sqrt{2m^2 + 2t^2})}{4(m-t)}$$

hvis $m = t \Rightarrow x_c = w/4$

$$\alpha_c = \alpha_0 + x_c \cdot r$$



if area = k · mass

we want A at $\frac{1}{4}$ length, C at $\frac{3}{4}$ L (cop)

and E at the same ex as C

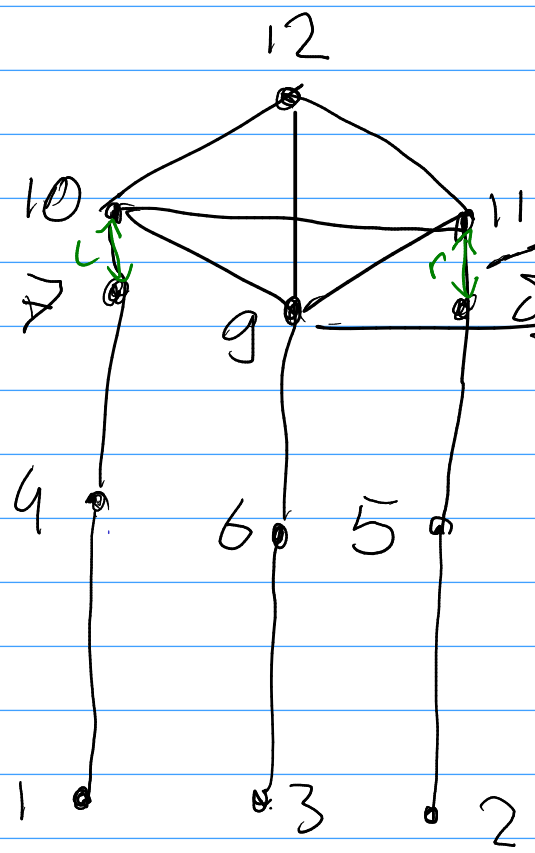
$m_a = \frac{1}{2}\ m_{kite}$

$m_c = \frac{1}{4}\ m_{kite}$

$m_d = \frac{1}{4}\ m_{kite}$

m_e = tether weight

points with 2 segments



points: 3 · seg + 4

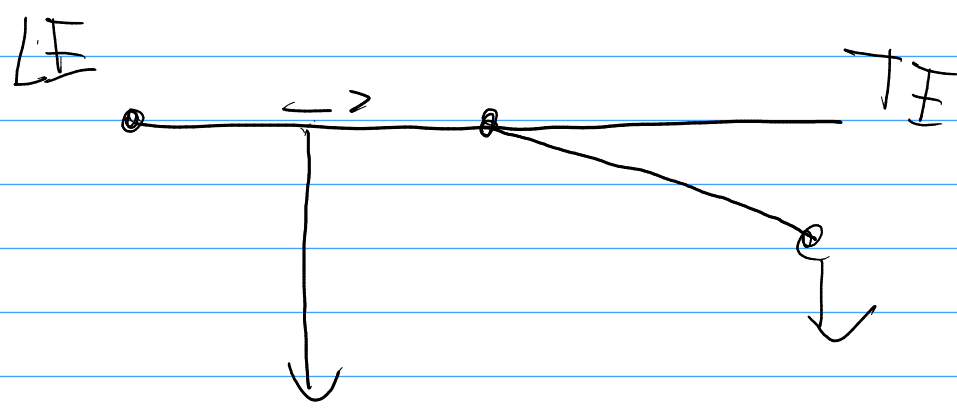
Length → directly change pos so that $F_{tether} = k \cdot F_{lift}$

segments · 3 + 3

pos[5] = pos[8] − c_r · l

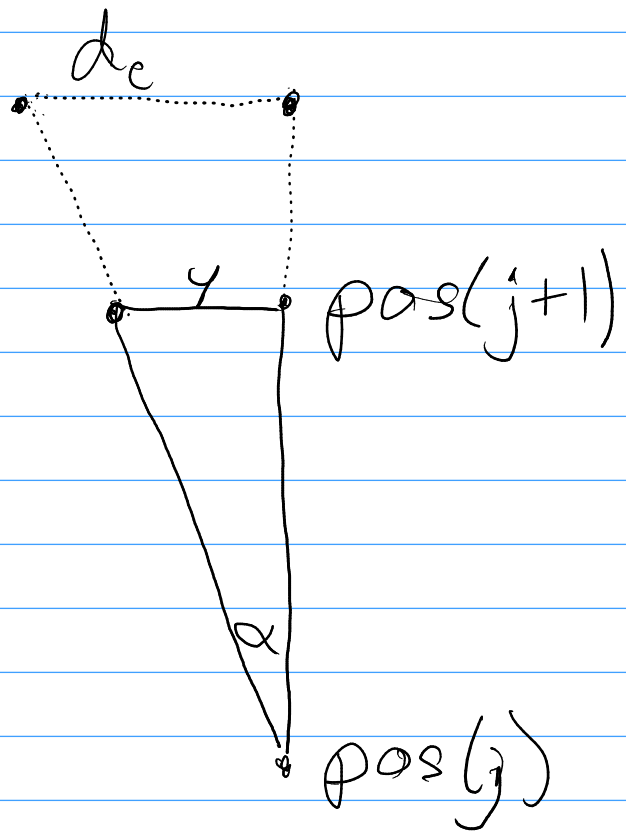
vel[5] = vel[8]

acc[5] = acc[8]



k = 0,1 ?

TE force should be small, k gets bigger with higher flap angle?


d_c
y
$pos(j+1)$
α
$pos(j)$