

Cessna 172 Lifting Line Model

$$\begin{aligned}
 N &:= 500 & \theta(m) &:= \pi \cdot \frac{m}{N+1} & b &:= 7.3 & Cla &:= 2 \cdot \pi \begin{bmatrix} -3 \\ -3 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ -3 \\ -3 \end{bmatrix} \\
 cc &:= \begin{bmatrix} \frac{44}{64} \\ \frac{44}{64} \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \end{bmatrix} & yy &:= \begin{bmatrix} -1 \\ -100 \\ 208 \\ 0 \\ 100 \\ 208 \\ 1 \end{bmatrix} \cdot \frac{b}{2} & tt &:= \begin{bmatrix} -3 \\ -3 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ -3 \\ -3 \end{bmatrix} \cdot \frac{\pi}{180} = \begin{bmatrix} -0.052 \\ -0.052 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ -0.052 \\ -0.052 \end{bmatrix} & yt &:= \begin{bmatrix} -1 \\ -0.75 \\ -100 \\ 208 \\ -0.25 \\ 0 \\ 0.25 \\ 100 \\ 208 \\ 0.75 \\ 1 \end{bmatrix} \cdot \frac{b}{2}
 \end{aligned}$$

$$cy(y) := \text{linterp}(yy, cc, y)$$

$$aaero(y) := \text{linterp}(yt, tt, y)$$

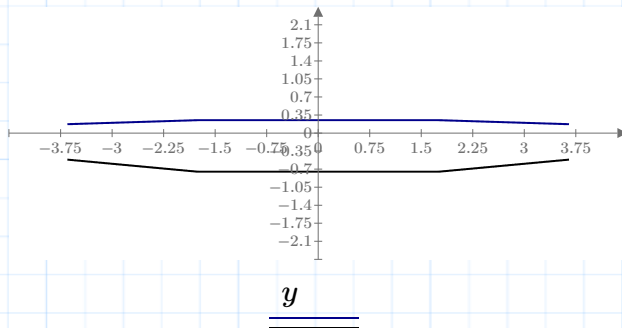
$$c(\theta) := cy\left(\frac{b}{2} \cdot \cos(\theta)\right)$$

$$aaero(\theta) := aaero\left(\frac{b}{2} \cdot \cos(\theta)\right)$$

$$cy_{fore}(y) := \frac{cy(y)}{4} \quad cy_{aft}(y) := -cy(y) \cdot \frac{3}{4}$$

$$S := \int_{\frac{-b}{2}}^{\frac{b}{2}} cy(y) dy \quad S = 6.708$$

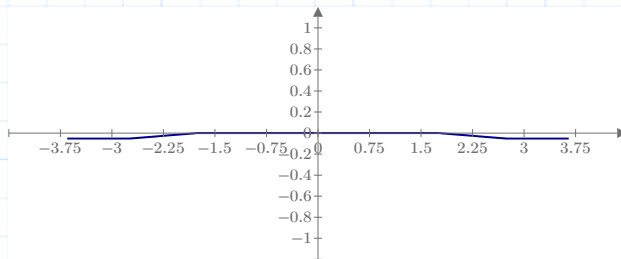
$$AR := \frac{b^2}{S} = 7.945$$



cy_fore(y)

cy_aft(y)

y



aaero(y)

y

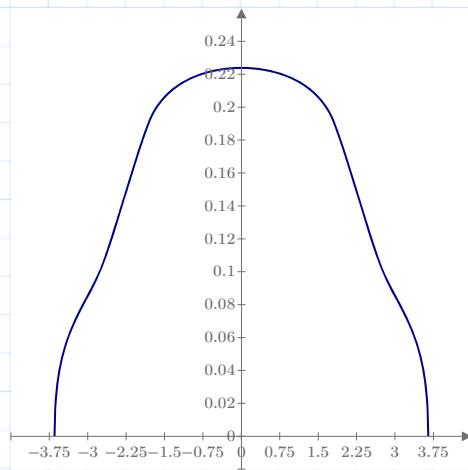
$$a(m, n) := \sin(n \cdot \theta(m)) + \frac{c(\theta(m))}{4 \cdot b} \cdot Cla \cdot n \cdot \frac{\sin(n \cdot \theta(m))}{\sin(\theta(m))} \quad aoa := \frac{5}{57.3}$$

$$r(m) := \frac{c(\theta(m))}{4 \cdot b} \cdot Cla \cdot (aoa + aaero(\theta(m)))$$

$$i := 1 \dots N \quad j := 1 \dots N$$

$$aa_{i,j} := a(i, j) \quad rr_j := r(j) \quad A := aa^{-1} \cdot rr$$

$$\Gamma a(x) := 2 \cdot b \cdot \sum_{k=1}^N A_k \cdot \sin\left(k \cdot \arccos\left(2 \cdot \frac{x}{b}\right)\right)$$



x

$\Gamma a(x)$

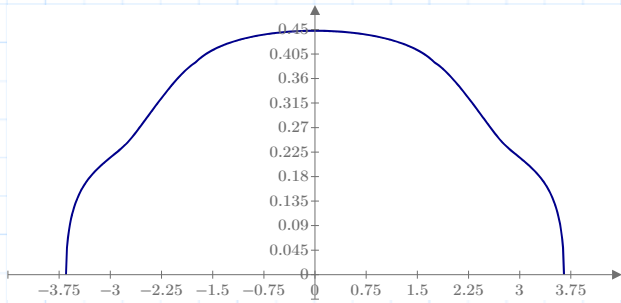
$A =$

$$\begin{bmatrix} 0.014 \\ -7.428 \cdot 10^{-18} \\ -0.002 \\ -2.507 \cdot 10^{-18} \\ 1.018 \cdot 10^{-4} \\ -2.376 \cdot 10^{-19} \\ 6.984 \cdot 10^{-4} \\ 2.393 \cdot 10^{-19} \\ -1.013 \cdot 10^{-4} \\ -2.098 \cdot 10^{-20} \\ -1.191 \cdot 10^{-4} \\ -2.341 \cdot 10^{-19} \\ \vdots \end{bmatrix}$$

$$CL := \pi \cdot \frac{b^2}{S} \cdot A_1 \quad CL = 0.352$$

$$CD := \pi \cdot AR \cdot \sum_{k=1}^N A_k^2 \quad CD = 0.005$$

Sectional Lift Coefficient



$$2 \cdot \frac{\Gamma a(y)}{c y(y)}$$

y