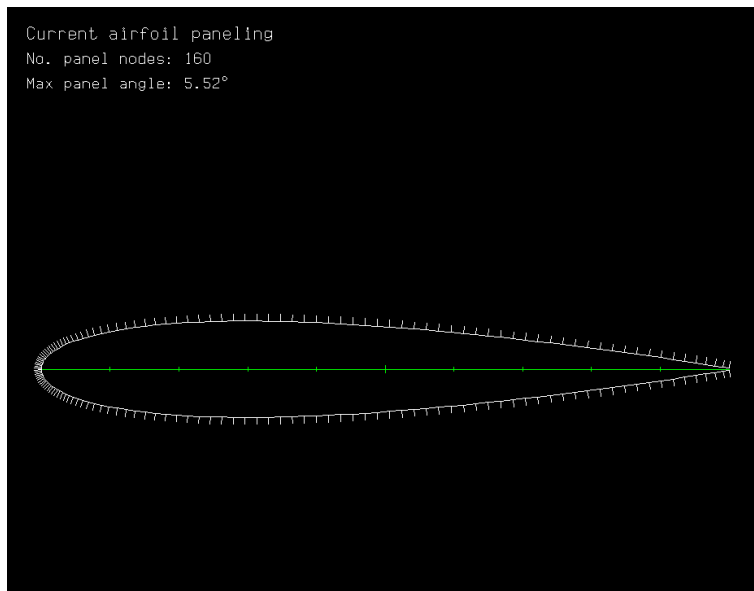


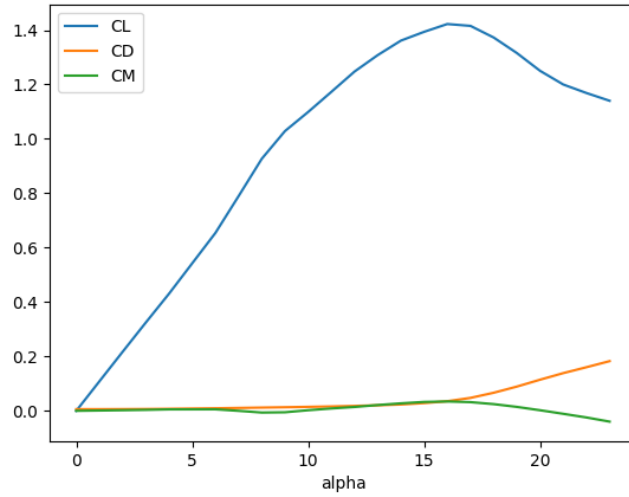
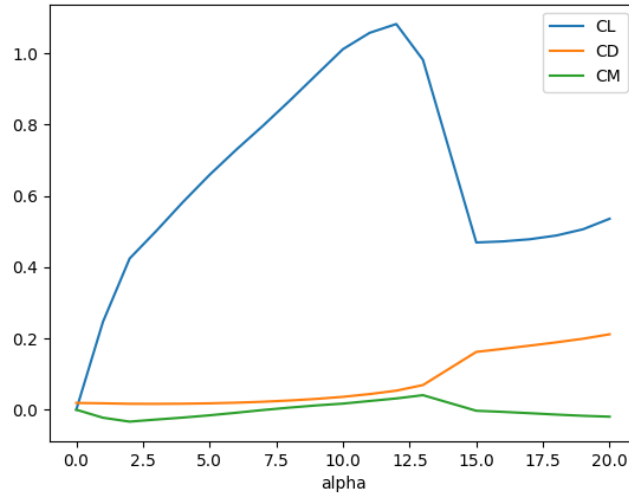
Aerodynamics Activity

Micaiah Smith-Pierce, Yohannes Kasseya

18-Feb-2017

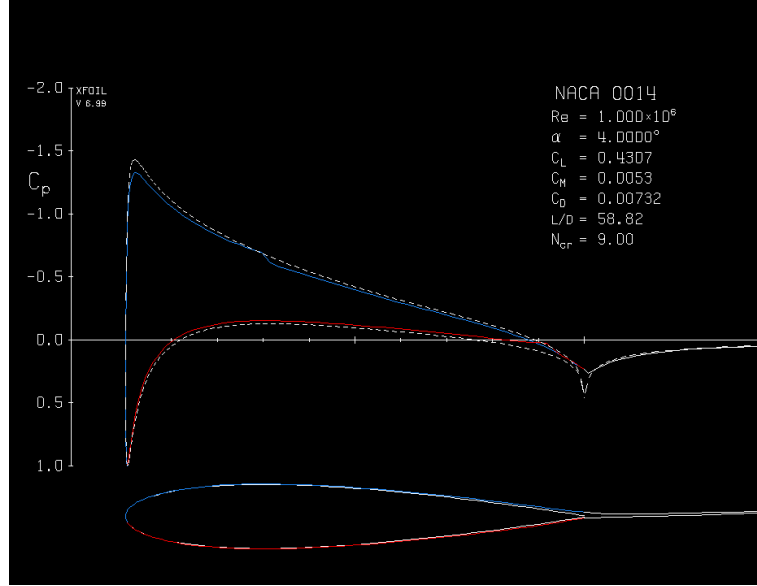


-
- The program clearly predicts stall. At approximately $\alpha = 12$ for $Re = 10^5$ and $\alpha = 15$ for $Re = 10^6$ C_L drops sharply, and shortly after that, C_D rises dramatically. C_M is also affected.



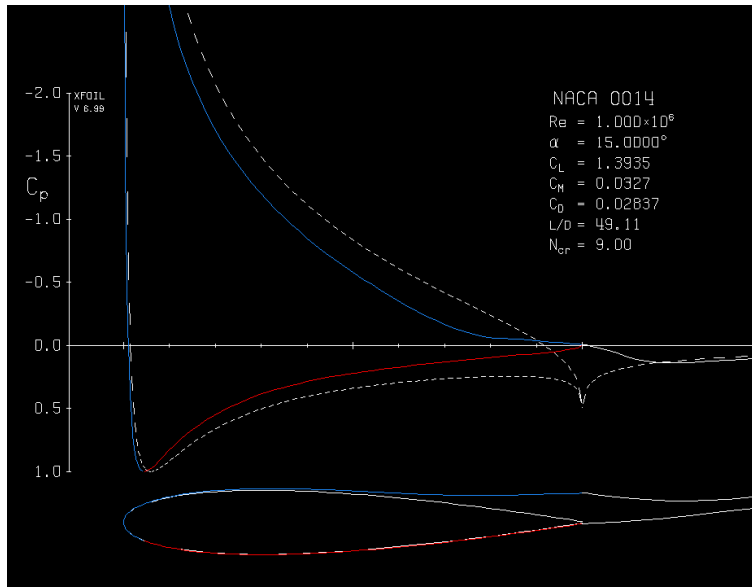
- The data set was restricted to the linear regime and a linear fit calculated using the `polyfit` function from Python's `numpy` library. In order to calculate the $C_{L\alpha}$ quoted here slope of said best fit line was converted from degrees to radians.
 - $Re = 10^5$: $C_{L\alpha} = 4.70$
 - $Re = 10^6$: $C_{L\alpha} = 5.40$
- For one thing, at every point along the chord, the pressure coefficient on the upper surface is less than on the lower surface. In addition, the

difference is largest near the leading edge and smallest near the trailing



edge.

- The distribution is considerably different. The C_P near the trailing edge is approximately zero instead of being positive. In general, the fact that the C_P deviates heavily from the inviscid prediction (dashed line) indicates stall. However, the airfoil does not appear to be completely stalled, since the C_P is close to the inviscid prediction near the leading edge, and the C_L is still near $C_{L_{max}}$.



- Using the spreadsheet from the atmosphere assignment, it was calculated that at 2500m, $\rho = 0.95kg/m^3$. Since calculating the Reynolds number would require knowing the velocity which we are endeavoring to obtain, the value of C_{D0} was initialized using $Re = 10^6$. An iterative process was used to find the actual value of Re and C_{D0} .
- Let the speed for minimum drag be denoted V_{min} . The equation below was used to calculate it:

$$\left(\frac{W^2}{S^2\rho^2C_{D0}\pi ARe}\right)^{\frac{1}{4}}$$

- The following equations were also used:

$$C_L = \frac{2W}{\rho V_{min}^2 S}$$

$$C_{Di} = \frac{C_L^2}{\pi ARe}$$

$$D = (C_{D0} + C_{Di})\frac{1}{2}\rho V_{min}^2 S$$

- V_{min} was calculated using the equation above, and used to find a more accurate value of Re . The value $\mu = 17.29 * 10^{-6}Pa * s$ was used (the temperature from the atmosphere assignment was passed as a parameter to the following online calculator:

www.engineeringtoolbox.com/air-absolute-kinematic-viscosity-d_601.html).

Subsequently, the value of Re obtained was used to calculate a more accurate value of C_{D0} , and so on, until it was discovered that:

$$V_{min} = 52m/s$$

$$Re = 5 * 10^6$$

- Using the equation given in part (7), the lift curve slope, in degrees, was found to be 0.1071. We then have $C_L = 1.01$ and $\alpha = 9.46^\circ$.
- In case it was not intended that we would calculate our own Reynolds number, $Re = 10^5$ was used to obtain the following values:

C_{D0}	0.01899
V_{min}	39m/s
C_L	0.60
$C_{L\alpha}$	0.11
α	5.59°