

# Aerodynamics and Aeroelasticity

## Homework 4

February 15, 2017

### **Problem 1**

Consider a thin, symmetric airfoil at  $1.5^\circ$  angle of attack. From the results of thin airfoil theory, calculate the lift coefficient and the moment coefficient about the leading edge.

### **Problem 2**

The NACA 4412 airfoil has a mean camber line given by

$$\frac{z}{c} = \begin{cases} 0.25 \left[ 0.8 \frac{x}{c} - \left( \frac{x}{c} \right)^2 \right] & \text{for } 0 \leq \frac{x}{c} \leq 0.4 \\ 0.111 \left[ 0.2 + 0.8 \frac{x}{c} - \left( \frac{x}{c} \right)^2 \right] & \text{for } 0.4 \leq \frac{x}{c} \leq 1 \end{cases}$$

Using thin airfoil theory, calculate

(a)  $\alpha_{L=0}$  (b)  $c_l$  when  $\alpha = 3^\circ$

### **Problem 3**

For the NACA 2412 airfoil, the lift coefficient and moment coefficient about the quarter-chord at  $-6^\circ$  angle of attack are  $-0.39$  and  $-0.045$ , respectively. At  $4^\circ$  angle of attack, these coefficients are  $0.65$  and  $-0.037$ , respectively. Calculate the location of the aerodynamic center.

### **Problem 4**

Consider an NACA 2412 airfoil with a 2-m chord in an airstream with a velocity of 50 m/s at standard sea level conditions. If the lift per unit span is 1353 N, what is the angle of attack?