22.581 Advanced Fluid Dynamics
Homework 4 : Due In Class Monday October 21st 2013

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This question is to be handed in. Other example problems from previous years may be helpful and are found on the course website.

In this problem, you will examine the following 5 different airfoils and determine how the pressure distribution around each is different (you can find GIF images of these airfoils on the UIUC airfoil database:

`http://aerospace.illinois.edu/m-selig/ads/coord_database.html#N`

- NACA 0012 : Symmetric, 12% thick airfoil

- NACA 0024 : Symmetric, 24% thick airfoil

- NACA 4412 : Cambered, 12% thick airfoil

- NACA 4424 : Cambered, 24% thick airfoil

- The FX 63-137 human powered aircraft airfoil (fx63137.dat or fx63137.gif)

1. Print the GIF image of each of the airfoils and use streamline curvature to approximately:

   (a) Sketch the coefficient of pressure distribution around each airfoil for a zero angle of attack (C_P vs. x/c).
   (b) Sketch on the same C_P vs. x/c plots how you think the pressure coefficient will change if the angle of attack was positive 5-degrees?
   (c) How susceptible do you think the airfoil is to flow separation?

   At the conclusion of this problem, you should have 5 plots, each with 2 pressure coefficient distributions on them. In addition, you should have the images of the 5 airfoils with the approximate streamlines around each.

2. Download XFOIL (see the handout provided and watch the tutorial if you feel so inclined), and use the program to analyze the above airfoils at a Reynolds number of $Re = 500,000$. For each of the airfoils, perform an analysis at 0 degrees and 5 degrees. You may also wish to determine when flow separation occurs for each airfoil.