AE 6020 High-Speed Flow
Computer Project #2 (worth 10% of grade)

On this assignment you will conduct inviscid and viscous analysis on the NACA 0012 and perform a design investigation. First, obtain the latest version of the NASCART-GT (Do not use the version used in Project #1)

1. Calculate the viscous flow (ivisc=2 in NASCART-GT) around the NACA 0012 airfoil at M_∞=0.6, $\mathrm{Re}_L = 1\times10^6$ over a range of angles of attack from $\alpha = 0^o$ to 16 deg. using the code. Plot the lift and drag coefficients vs angle of attack (every 2 deg.) and explain the reasons for the trends observed. Is M_∞=0.6 beyond the critical Mach number for any of the angles of attack investigated? Explain.
2. Use the output from bodytab.dat to plot the moment coefficient vs. angle of attack for each of the cases above. Explain the reasons for the trends observed.
3. Plot the Cp distribution for the airfoil in inviscid flow at M_∞=0.85 and $\alpha = 1.5^o$. Investigate modifications of the upper surface of the airfoil (without changing the lower surface geometry) by adding no more than 3 shape functions. Develop a modified version of the airfoil which has as low a drag coefficient value as possible without any reduction in lift coefficient relative to the baseline geometry at these same flight conditions. Do not allow the maximum thickness ratio of the airfoil to decrease. Do not allow an increase in trailing edge thickness. Note: For simplicity you do not have to prove that your final result is a global optimum but you do need to fully document your strategy, and the aerodynamic results obtained for the geometries investigated. Perform this entire design using inviscid analysis only.
4. For the baseline NACA 0012 airfoil and for your optimized design, report the lift, drag and pitching moment coefficient (about ¼ chord location) results and provide a plot which shows the baseline and modified geometry shape on the same graph. Also provide a single plot which compares the Cp distribution of the NACA 0012 airfoil and your improved geometry. Provide color shaded plots of computed Mach number in the 2-D field around the baseline and optimized airfoils.