8 Airfoil Design Considerations

8.1 Introduction to Airfoil Design
8.2 Subcritical-Speed Airfoils M < 0.7
8.3 Transonic Airfoils 0.7 < M < 0:9
8.4 Supersonic-Speed Airfoils 0.9 < M < 2
8.5 Multi-element Airfoils for High Lift
8.6 Optimization Example - ADODG Test Case RAE2822

Exercises and Projects – software here Tutorials, MSES, and SU2
Review questions to consider before doing calculations

1. Explain the scenarios leading edge stall and trailing edge stall.

2. Sketch pressure distributions for peaky, roof-top, and supercritical airfoils at Mach-numbers where the differences are of importance.

3. Sketch the effect on the lift curve of applying leading edge slats and/or trailing edge flaps (four cases !)

4. Explain the "inverse mode" airfoil design principle

Airfoil computations

5. The P-80 airfoil used in Fig. 8.9 is much thicker than the competitors in that graph and predictably comes in last in the race. Find the NACA65-213 airfoil coordinates e.g. on the UIUC airfoil data site ***https://m-selig.ae.illinois.edu/ads/coord_database.html***. Download the coordinates, write a program to read the file, scale y-coordinates to 10% thickness, and write to a new file. Complete that file to conform to the `blade.xxx` file format used for `mses`, and compute its transonic drag rise and compare to that of the other airfoils in Figure 8.9.

6. Compare by `msis` calculations the Goe298 and RAF15 airfoils at *M* and *Re* relevant for the WW 1 aircraft. The idea is to look for maximum lift. The RAF foil was used in the Ch. 5 exercises and many other foils are found there. You will find that `msis` gives up on the RAF foil with quite low c_{lmax}, even when the lift curve has only small slope decrease. Is this bona fide stall or just `msis` incompetence?
   Look at the separation bubble movement on RAF foil. One may expect large-scale separation when the bubble moves into the high adverse pressure gradients at the foil nose. Is this what you observe? Compare to similar computations with the Goe298 foil.

7. The c_{lmax} problem is to be analyzed by RANS calculations for a naca2315 airfoil at M 0.5. Run an alpha sweep as high as SU2 will converge with all-turbulent flow and Re for sea-level flight and a wing chord of 2 m. How does this compare to the `msis` results?