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Advanced Aerodynamics

Project-I
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Computation of Streaming Motions about Airfoils

We have examined two numerical methods for computing streaming motions about an airfoil:

- A. Source methods for thick non-lifting airfoils.
- B. Doublet method for lifting airfoils with thickness.

We want to use these methods to calculate flows about NACA-xxxx airfoils. However, to validate our results we first calculate equivalent flows about Joukowski airfoils with the same angle of attack, thickness and camber ratios.

1. Find the Joukowski airfoils with the same thickness and camber ratios as NACA0006, NACA0009, and NACA4409. Plot on the same figure, for comparison, the profiles for the NACA and Joukowski airfoils with the same thickness and camber ratios. Plot the pressure distribution along the Joukowski airfoils at angles of attack, $\alpha = 0^\circ, 5^\circ,$ and 10° . Plot the lift coefficient versus α and compare the effects of camber and angle of attack.
2. Use the source method to calculate the flow about NACA0006, NACA0009, and NACA0012. Plot the pressure distribution along the airfoil and compare the results with the Joukowski airfoils.
3. Use the doublet method to calculate the flow about NACA0006, NACA0009, NACA4409, at angles of attack, $\alpha = 0^\circ, 5^\circ,$ and 10° . Plot the pressure distribution along the airfoils and the lift coefficients versus α and compare the results with the Joukowski airfoils.
4. Add a flap to the airfoil and repeat item 3. Comment on the effect of the flap on modifying the pressure and augmenting the lift.