Problem 136A

Prepare a computer program to compute the coordinates of a series of points (say 100 in number) on the surface of Joukowski airfoils. Incorporate routines to evaluate the chord of the foil, c_A, the lift coefficient, C_L, and the important performance parameter, $dC_L/d\alpha$.

(a) Plot the shape of two Joukowski foils including ($c/a = 1.1$, $\beta = 5°$). Scale the coordinates so that the chord is unity.

(b) Demonstrate graphically how the lift, C_L, and the parameter, $dC_L/d\alpha$, depend on the camber as represented by β and on the thickness as represented by c/a. (Plot C_L and $dC_L/d\alpha$ against α for a number of choices for β and c/a.) What conclusions would you draw concerning the dependence of $dC_L/d\alpha$ on the camber and thickness of the foil ?

(c) Prepare graphs of the pressure distribution (as represented by C_p) on both the pressure and suction surfaces for the Joukowski foil $c/a = 1.1$, $\beta = 5°$ at an angle of attack of 5°.

(d) Modify the results of (c) by evaluating the coordinate s measured along the surface from the stagnation point and plotting C_p as a function of distance from the stagnation point in both directions. [You will use this information later for a boundary layer calculation.]

(e) Describe how you would evaluate the added masses, M_{11}, M_{12}, M_{21}, and M_{22} where the indices 1 and 2 denote rectilinear motion in x and y directions. If there is time and if you so wish you might consider computing these added masses (non-dimensionalized by ρc_A^2).