

Homework #6 • MATH 462 • Pre-Flight Check

- submit your write-up Friday 27 February.
- in-class midterm reminder: Monday 01 March.

A) Vortex Near the Ground (3 pages, 10pts) Use the method of images to construct the complex potential for a line vortex (at $z = +i$, with circulation $\Gamma = 1$) in the vicinity of a ground plane (at $\text{Im}z = 0$). Make a sketch of the flow contours — they are related to Figure 4.2 in Acheson.

Express $\Phi'(z)$ as a Laurent series about $z = i$. Next, apply the Blasius force integral for a suitable body imbedded in your flow (indicate on your sketch). Can you use this result to explain why the vortex in the airplane landing video moved as it did?

B) Plotting an Airfoil (1 page + plot, 10pts) Following Acheson, section 4.9

In view of Figs 4.5 and 4.6 it will come as no surprise that if we use the mapping (4.56) on a circle in the z -plane which passes through $z = a$ but which encloses $z = -a$, we obtain an airfoil with a rounded nose, but a sharp trailing edge . . .

Verify this statement by plotting an asymmetric airfoil using the Zhukovsky transformation

$$Z = z + \frac{a^2}{z} .$$

The plotting command *axis equal* may be needed to get the image to look right. Give a formula for the angle which the trailing edge makes with the horizontal, and use your plot to verify its correctness.

