

## Homework #6 • MATH 462 • Last Questions for Potential Flow

- submit your write-up noon, Friday 10 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?

**bonus:** Incorporate a second vortex line to account for the vertical motion.

**\*) Plotting an Airfoil** (optional) 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 aerofoil 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.

