

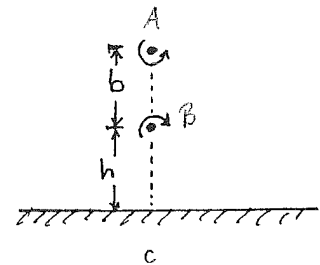
HOMEWORK: 2-D VORTEX INTERACTIONS

(Fluid Dynamics and Turbulence Modeling, UofUdine, Dec. 2010, L. Sigurdson)

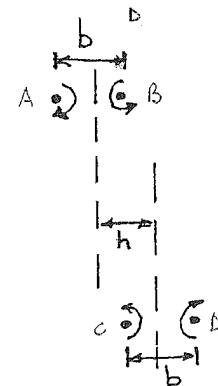
(Assume the absolute magnitude of all circulations for vortices mentioned are the same unless otherwise stated.)

1. It is said that a vortex ring that is aimed near a globe will have its trajectory changed as if there was some “gravitational” attraction deflecting its trajectory. To help understand this, consider what would happen to a counter-rotating vortex pair near a frictionless wall as shown in the figure.

Discuss the general behaviour of these vortices as a function of h and b . First get as far as you can with any analytical arguments, short of calculating trajectories, then verify your conclusions by running this on the Matlab program. Is there a critical relationship for h and b for something interesting to happen?



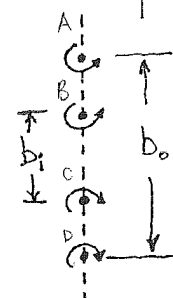
2. What will happen if colliding counter-rotating vortex pairs are initially displaced off-axis by an amount h ? Describe the general motion and any critical values of h and b you might find. First try and guess the behaviour and then run Matlab for various values of h and b .



3. Consider the vortices shown. As before, first use your own reasoning, and then run Matlab.

a) Describe the motion of these vortices.

b) What happens when b_i / b_o is greater than $3 - 2\sqrt{2}$?



4. Investigate what happens for identical vortices placed at the corners of a rectangle. What happens if one of the vortices is displaced slightly or its strength is changed slightly?

5. Investigate a multi-vortical interaction of your own invention.