

Lecture F06 Mud:

- 1. Which came first, Biot-Savart for E&M or for Fluids?** (2 students)
Not sure. Biot-Savart was first used for Fluids in the mid 1800's by Helmholtz.
- 2. Is there some sort of Gauss's Law for vortices to avoid doing the Biot-Savart integral?** (1 student)
Nope. Gotta deal with it as is.
- 3. How is $V_\theta = \Gamma/2\pi r$ for the straight 3-D vortex in the first example?** (1 student)
I'm not sure what you mean. Carrying out the Biot-Savart integral on the straight 3-D vortex produced $V_\theta = \Gamma/2\pi h$, where h was the perpendicular distance from the vortex. This is the same as the 2-D result, except that r was replaced with h (following Anderson's notation).
- 4. If the circulation is greatest at the tips, is the lift greatest at the tips also?** (1 student)
I think you're confusing the circulation Γ with the wake vortex strength $\gamma = -d\Gamma/dy$. The circulation Γ and hence $L' = \rho V_\infty \Gamma$ both go to zero at the tips. In contrast, γ is typically maximum near the tips.
- 5. Confused about sign conventions for Γ and γ ?** (4 students)
 Γ on the wing is defined positive about the y -axis by righthand rule.
 γ in the wake is defined positive about the x -axis by righthand rule.
- 6. What would $\gamma(y)$ for a wing with a winglet look like?** (1 student)
First of all, the vortex sheet in this case is not planar, but is upturned on the edges, following the winglets. So γ has to be treated as a function of arc length s along the span – first along y , and then along z following the winglet. Qualitatively, $\gamma(s)$ looks similar to that of a flat wing. The largest γ typically occurs near the winglet's tip. There may also be a “spike” in γ at the wing/winglet junction, depending how the wing/winglet system is designed.
- 7. In the PRS, if Γ is constant, why isn't $d\Gamma/dy = 0$?** (1 student)
 Γ is not completely constant – it sharply drops to zero at the tip over a very small distance. So $d\Gamma/dy = 0$ over most of the span, but it's large where Γ is sharply dropping to zero.
- 8. Are we finding the downwash at one point y_o , or over the whole span?** (1 student)
When doing the integral to compute w , we hold y_o fixed. But this y_o is left as “ y_o ” rather than a specific number, so the result is an expression in terms of y_o . We can then plug in a range of y_o values into the expression to create points for the w versus y_o plot.
- 9. How did you decide that $dw = \gamma dy/4\pi(y_o - y)$?** (1 student)
This is an application of the Biot-Savart law to the vortex filament consisting of a dy -wide strip of the wake, with circulation γdy .

10. **What does the induced angle distribution tell me?** (1 student)

It will be used to compute the loading on the wing, and hence the lift and induced drag.

11. **Didn't understand PRS?** (3 students)

I'll go over it in recitation.

12. **No mud** (9 students)