Lecture F18 Mud: Lift, Kutta condition, Vortex Sheets
(24 respondents)

1. **How do you know that $r_1 = r_2$, so $(\ln r_2 - \ln r_1) = 0$?** (1 student)
   A closed circuit used to define Γ is closed, so it starts and ends at exactly the same radius $r_1 = r_2$. This is not true of the angles: $\theta_1 \neq \theta_2$ if the circuit goes around the origin.

2. **What does the term $(x - s)$ in the ϕ equation represent?** (1 student)
   x, y is the location where $\phi(x, y)$ is being computed, and s is the x-location of the ds piece of the sheet. So $x - s$ is the horizontal distance between the x, y point and the ds piece. Using the geometry triangle, we have

   $$r = \sqrt{(x-s)^2 + y^2} \qquad\qquad \theta = \arctan[y/(x-s)]$$

3. **How did you get $L' = (p_\ell - p_u)c$ in the PRS question?** (2 students)
   This is just the integration of the pressure force on a this airfoil, which we covered early on:

   $$L' \;=\; \int_0^c (p_\ell - p_u)\, dx \;=\; (p_\ell - p_u)c$$

   since in this case $p_\ell - p_u$ is a constant.

4. **Why does $\Gamma_{\text{inside}} = \gamma/2$?** (1 student)
   Actually, it's

   $$\Gamma_{\text{inside}} = \gamma\, \Delta s$$

   This is the net vortex strength of the Δs piece of the vortex sheet that's inside the little control volume.

5. **How do you generate source strengths (λ) for the panels?** (1 student)
   A computed program does it in practice. The λ_j strengths of all the $j = 1, 2, \ldots n$ panels are the unknowns in the $n \times n$ linear system. They are computed by solving this system using Gaussian elimination.

6. **What program did you use to generate the plots?** (1 student)
   I have several panel analysis programs and little graphics programs I've put together over the years. Some of these are on Athena.

7. **Will we use panel methods this year?** (1 student)
   No, but we will use Xfoil early next term. This is a 2-D panel method for airfoils.

8. **When a body is modeled using sources, is it producing a net airflow?** (1 student)
   Good question! In summary, no. If the body is closed, then there will be an equal overall source and sink strengths between all the panels. The total integrated strength will be zero:

   $$\sum_{j=1}^{n} \lambda_j\, \Delta s_j \;=\; 0$$

9. **No mud** (14 students)