Lecture F17 Mud: Source sheets, panel method
(31 respondents)

1. **Λ is "source strength"? I thought it was $\dot{\mathcal{V}}/\ell$?** (1 student)
It's both. Λ is simply called the "source strength". That's just a name for it. It is also equal to the volume flow per span, or $\dot{\mathcal{V}}/\ell$. That's an observation/interpretation/consequence of a source of strength Λ.

2. **Do we have to be able to do all those integrals?** (2 students)
No. They are very messy to evaluate, and you can always look them up in integral tables, or in any good book on panel methods. In practice, the big formulas would be coded in an Ada or C subroutine, or Matlab script, and could then be forgotten. The important thing is understanding how the integrals represent $\phi(x, y)$ or $u(x, y)$ or $v(x, y)$.

3. **How did you get $\pm\lambda/2$ for the normal velocity?** (1 student)
By writing down the big messy formula for $v(x, y)$, and taking the limits $y \to 0^+$ and $y \to 0^-$. Filling up the board with this algebra would not be very productive. The final result is the important thing.

   By the way, the math is identical to the case of an infinite sheet of electrostatic charge/area density q. We get that the electric field is $E = q/2$ directed normal to the sheet. The analogy is $q \longleftrightarrow \lambda$, and $E \longleftrightarrow V$,

4. **Can there be sink panels?** (1 student)
A sink panel is simply a source panel with a negative λ. The streamline pattern is the same, but the flow direction is reversed.

5. **Why do the panels interfere with each other's normal velocity?** (1 student)
A panel's velocity does not affect only its surface points, but reaches out to all points in the xy plane. In particular, a panel's normal velocity is not just its own $\lambda/2$ contribution, but also includes the contributions from all the other panels present. Everything must be accounted for when setting $\vec{V} \cdot \hat{n} = 0$ on each panel.

6. **Is there a way to derive a function which gives the interference between the panels?** (1 student)
The A_{ij} matrix does exactly that. By solving the $n \times n$ linear system, we in effect correct the normal flow at each panel for the contributions from all the other panels.

7. **How do you calculate the A_{ij} matrix?** (1 student)
By evaluating $\vec{V} \cdot \hat{n}$ for each panel midpoint x_i, y_i, using the "messy" integrals. Only the panel geometry is required. Anderson 3.17 has more details.

8. **Can you give more examples of the panel method?** (1 student)
I'm not sure what you mean by "examples". A panel method requires massive computation. Even a modest problem with 100 panels requires $100^2 = 10000$ evaluations of the messy integrals to obtain the A_{ij} matrix. It's futile and quite pointless to do any of this by hand.

   I can show some application examples of panel methods for real airplane geometries.

9. **Will we be responsible for solving panel problems?** (1 student)
   No. There are computer programs that do this (see above). You will be responsible for conceptual understanding of how source sheets can be used to model the flow about a body.

10. **You lost me with the matrices and solution technique.** (1 student)
    Anderson 3.17 goes over this, although he buries the concepts in an algebra blizzard. The notes try to go over the same stuff at a more cenceptual level, which is what's really important.

11. **Can you explain the second PRS?** (1 student)
    Perhaps in recitation.

12. **No mud** (18 students)