Computational Aerodynamics Questions & Answers

Question by Student 201527110

Professor, I don't understant what does 'Semi Disc. equation' exactly what we do last lecture. Usually, scalar equation can be denoted as

$$\frac{\partial u}{\partial t} + a\frac{\partial u}{\partial x} = 0$$

, but I wonder why we didn't considered about wave speed 'a' in 'Semi Disc. equation'. (I think you noted semi disc eq as $\frac{u_i^{n+1} - u_i}{\delta t} + \frac{u_{i+1/2} - u_{i-1/2}}{\delta x} = 0$*)*

That's a mistake: I should have added the sound speed of course. Please correct your notes. Because it is constant, an easy way to add the sound speed is to change Δt to $a\Delta t$ everywhere Δt appears. This will make more sense! 2 points bonus.

Question by Student 201427564

Professor, when you explain about 'Roe Average', you wrote like this. $A_{i+\frac{1}{2}}(U_{i+1} - U_i) = F_{i+1} - F_i$*. I can not understand that how can it be possible that* $A_{i+\frac{1}{2}}U_{i+1} = F_{i+1}$ *and* $A_{i+\frac{1}{2}}U_i = F_i$ *. Because subscript of A and U are different each other.*

Hm, I don't understand the question. You need to explain better what you don't understand..

Question by Student 201427564

Oh.. I mean How can it be possible that $A_{i+\frac{1}{2}}U_{i+1} = F_{i+1}$ *rather than* $F_{i+\frac{1}{2}}$ *. Are there any rules?*

I'm not sure what you mean. But it is not correct that $A_{i+1/2}U_{i+1} = F_{i+1}$. This is not the Roe average. The Roe average if $\Delta F = A_{i+1/2}\Delta U$. I'll give you 0.5 point for the effort.

Question by Student 201427102

Professor, I'm confused. For finding $F^-_{i+1/2}$*, you used below form.*

$$r_i^- = \frac{F_i^- - F_{i+1}^-}{F_{i+1}^- - F_{i+2}^-}$$

According to table, this form for alpha < 0. But alpha > 0 at Q#2 of assign.#8.

What does "alpha" mean? I didn't use this in class. You need to rephrase your question and use the same symbols as used in class. Or, define clearly a new symbol you are introducing.

Question by Student 201427102

Professor, I'm confused. For finding $F^-{}_{i+1/2}$, you used below form.

$$r_i^- = \frac{F^-{}_i - F^-{}_{i+1}}{F^-{}_{i+1} - F^-{}_{i+2}}$$

According to table, this form for a< 0. But a>0 at Q#2 of assign .

Node	u, m/s	a, m/s
$i-1$	0	100
i	10	110
$i+1$	9	105
$i+2$	-10	100

Now I see what you mean. When dealing with a system of equations, the wave speeds are not necessarily a or u. Rather, the wave speeds are the eigenvalues. So, when determining $F^{\pm}_{i+1/2}$, the wave speeds are within $\Lambda^{\pm}$ (those play the same role as the "a" does for a scalar equation). 1.5 point bonus.

Question by Student 201427564

Professor, I have a question about $\phi(r)$. In the table, $\phi(r) = max(0, min(1, r))$. But last class, you wrote like this. $(\phi^+{}_{i+\frac{1}{2}})_1 = max(0, min(1, 2r^+{}_i))$ Why did you use $2r^+{}_i$ rather than $r^+{}_i$?

Both $\phi = \max(0, \min(1, r))$ and $\phi = \max(0, \min(1, 2r))$ respect the rule of the positive coefficients and reduce to first order at extrema and are hence valid. But $\phi = \max(0, \min(1, 2r))$ is better because it is closer to the second-order stencil. 1.0 point bonus.

Question by Student 201227147

Professor, I have a question about assignment 8 question #2-(b). Last class, you calculated r_i^- to find out $\phi^-_{i+1/2}$ because you used this relationship I guess:

$\phi^-_{i+1/2} = max(0, min(1, 2r^-_i))$

However, I think r^-_i *should be* r^-_{i+1} *because* $\phi_{i+1/2}$ *is* $\phi^-_{i+1/2}$*. Is it right? or is there some reasons you calculated* r^-_i *?*

Hm no, if we set $\phi^-_{i+1/2} = \max(0, \min(1, 2r^-_{i+1}))$ then we should define $r^-_{i+1} \equiv \frac{u_i - u_{i+1}}{u_{i+1} - u_{i+2}}$. However, because $r^-_i \equiv \frac{u_i - u_{i+1}}{u_{i+1} - u_{i+2}}$ then we have to set $\phi^-_{i+1/2} = \max(0, \min(1, 2r^-_i))$. 1 point bonus.

Question by Student 201227147

I have another question about r^-_{i+1}*. In the table,* $r_i = \frac{u_{i+1} - u_i}{u_i - u_{i-1}}$*. But you calculated* r^-_i *with* $r^-_{i+1} \equiv \frac{u_i - u_{i+1}}{u_{i+1} - u_{i+2}}$*. Does it mean that the equation in the table is assumed positive upwind (from left*$(i-1)$ *to right*$(i+1)$*) so that notations should be from right(*$i+2$*) to left(*i*) when I apply it in negative upwind case?(it means* $i-1$->$i+2$*,* i->$i+1$*, and* $i+1$->i*)*

By the way, Does your answer about previous question mean that there's just difference in notating r *and use same equation?*

I guess your concerns are due to the fact you are using an older version of tables.pdf.. The tables have changed slightly in the last few days. After downloading the latest version, if you still have some concerns, ask the question again below.

Question by Student 201238707

Professor, I have a question about subsonic inflow's velocity angle. Why those are same?

$\theta_1^{n+\frac{1}{2}} = \theta_1^{n+1}$

because we assumed steady-state?

I don't recall this step. You need to put your question into context so I can recall why we did this.

Question by Student 201238707

when we found velocity vector u_1^{n+1} *&* v_1^{n+1}*. we extrapolated* $u_1^{n+\frac{1}{2}}$ *&* $v_1^{n+\frac{1}{2}}$*. And we put* $\theta_1^{n+\frac{1}{2}} = \theta_1^{n+1}$ *then used*

$$\theta_1^{n+1} = atan(\frac{v_1^{n+1}}{u_1^{n+1}}) = atan(\frac{\alpha * v_1^{n+\frac{1}{2}}}{\alpha * v_1^{n+\frac{1}{2}}})$$

but i wonder why those θ are same?

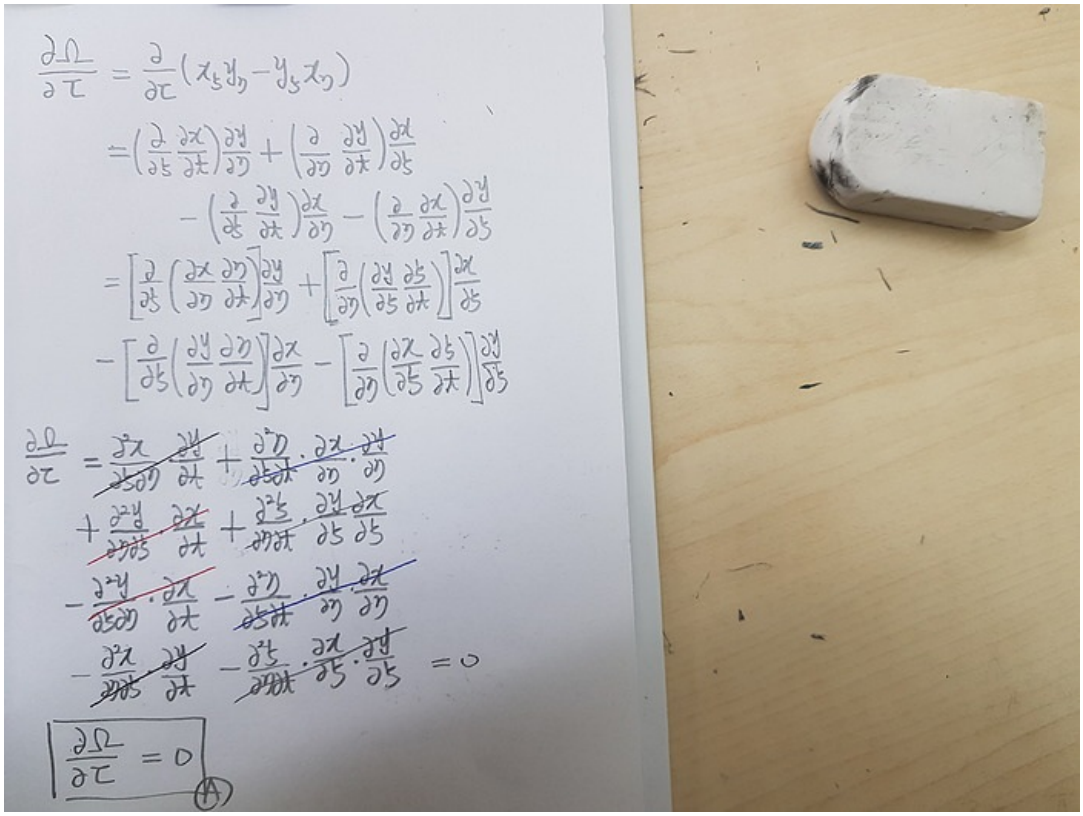
I don't understand. What other value would you give it?

Question by Student 201227147

Professor, in the section 2 of the table (Euler Equation in Generalized Coordinates), it says that $Q \equiv \Omega U$. But I guess it should be $Q \equiv \Omega \Gamma U$.

True, but $\Gamma = 1$, so it doesnt' matter in this case. 1 point bonus.

Question by Student 201327132



Professor, This is answer of thursday question. It is not relate that mesh doesn't change in time.

This is great! 2.0 points bonus. I would have given you 3 points bonus if you would have typeset it using LaTeX.

Question by Student 201327132

Professor, Assignment 2 deadline is described Tuesday 29th March. So That confused me.

Its due on Thursday. I fixed the mistake.