Computational Aerodynamics Questions & Answers

Question by Student 201127151

Professor, I have a question about Ω. You said that $\Omega = x_\xi y_\eta + y_\xi x_\eta$ and it means the area of a cell. I understood that Ω represents area because its dimension is $[m^2]$. But I don't understand that it is the area of a cell. Is it just the definition, or can we demonstrate it?

Good question. I have pondered this as well when I first encountered the generalized coordinates.. The definition of Ω is simply $x_\xi y_\eta + y_\xi x_\eta$, not the cell area. But it is very close to the cell area thus. In the next assignment, I will ask you to compare the cell area with Ω and assess the differences. I'll give you 2 points bonus.

Question by Student 201427142

Professor, I still cannot understand about Γ in quastion by student #201527110

$$\Phi_1 = U \frac{\partial}{\partial \tau}(\Omega\Gamma) = U \frac{\partial}{\partial \tau}\left(\frac{\partial x}{\partial \xi}\frac{\partial y}{\partial \eta}\frac{\partial \tau}{\partial t} - \frac{\partial y}{\partial \xi}\frac{\partial x}{\partial \eta}\frac{\partial \tau}{\partial t} \right)$$

at here

$$\frac{\partial}{\partial \tau}\left(\frac{\partial x}{\partial \xi}\frac{\partial y}{\partial \eta}\frac{\partial \tau}{\partial t} \right) = \left(\frac{\partial}{\partial \tau}\left(\frac{\partial x}{\partial \xi} \right) \right)\frac{\partial y}{\partial \eta}\frac{\partial \tau}{\partial t} + \frac{\partial x}{\partial \xi}\left(\frac{\partial}{\partial \tau}\left(\frac{\partial y}{\partial \eta} \right) \right)\frac{\partial \tau}{\partial t}$$
$$+ \frac{\partial x}{\partial \xi}\frac{\partial y}{\partial \eta}\left(\frac{\partial}{\partial \tau}\left(\frac{\partial \tau}{\partial t} \right) \right)$$

and I understand 1st and 2nd in right term. But I think that the 3rd term($\left(\frac{\partial}{\partial \tau}\left(\frac{\partial \tau}{\partial t} \right) \right)$) cannot be omitted. Because $\frac{\partial \tau}{\partial t}$ is still depending on τ. How can we assume $\Gamma = 1$??

We can set Γ to any value as long as it respects the dependency we originally specified. That is, $\Gamma = \partial \tau / \partial t$ should be such that $\tau = \tau(t)$. Thus, we can choose Γ to be 1 or t or t^2 but not x or tx, etc. Here, it is perfectly fine to choose $\Gamma = 1$. One advantage of choosing $\Gamma = 1$ is that

$$\frac{\partial}{\partial \tau}\left(\frac{\partial \tau}{\partial t} \right) = \frac{\partial}{\partial \tau}(\Gamma) = \frac{\partial}{\partial \tau}(1) = 0$$

If Γ would have been chosen as t or t^2, then the latter wouldn't be 0, and this would lead to $\Phi_1 \neq 0$, and this would prevent us to write the Euler equations in generalized coordinates in conservative form. I'll give you 2 points bonus boost.

Question by Student 201427564
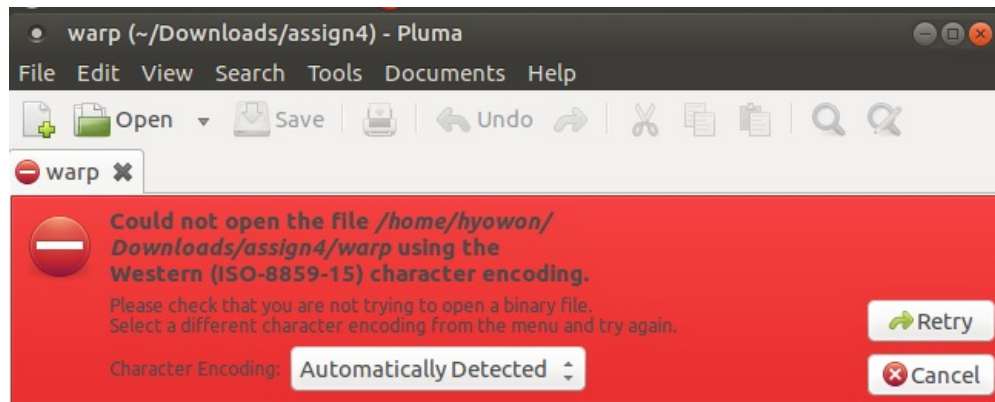
*Professor, When I try to open warp file through 'Pluma', this error occured. How should I do?*

Warp is a binary file (executable), so it can not be opened in pluma. With pluma you can open text files like .wrp or .txt or .c etc. Please don't do assignment #4 now: the tgz package is not complete yet. I'll explain what to do in assignment 4 tomorrow.

Question by Student 201427564

Professor, I wonder about difference between 'EE' and 'NO'. 'E' makes mesh equally space and 'NO' also. Can we adjust distance with 'E' like below? Block(is,js,ie,je, EE,0.5,2,2, NO); Also, is it right that 'NO' only makes mesh equally 1? (like default) I know this is very basic question but I want to know clearly. Thank you.

Hmm, I am not sure what your first question is.. As for the second, 'NO' does not make the mesh equally 1, it simply needs to be used when the block is 1D (when there are no segments along a certain dimension). I'll give you 1 point bonus boost.
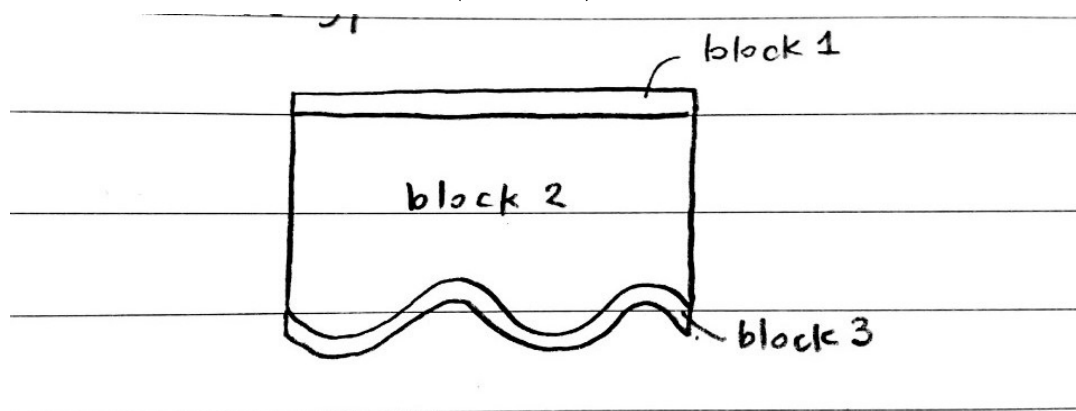
Question by Student 201427102
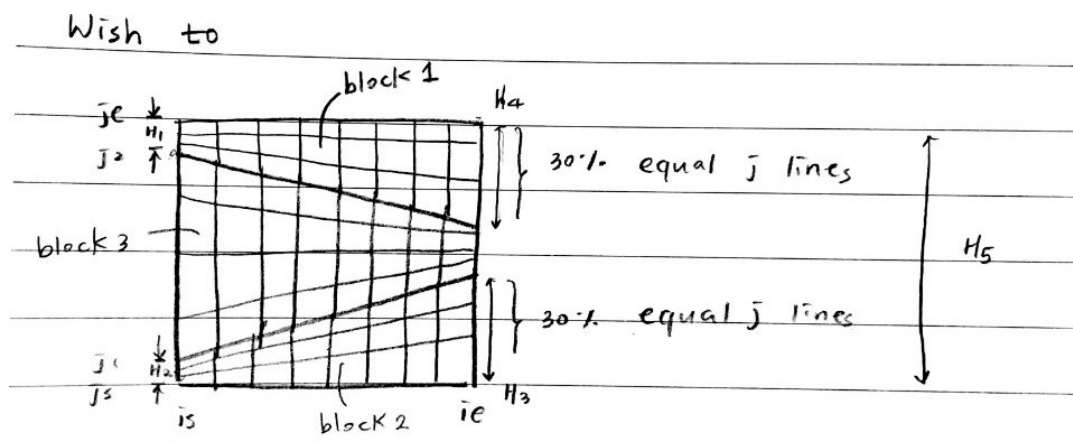
for middle block, you use "BLOCK(,GG,   );"
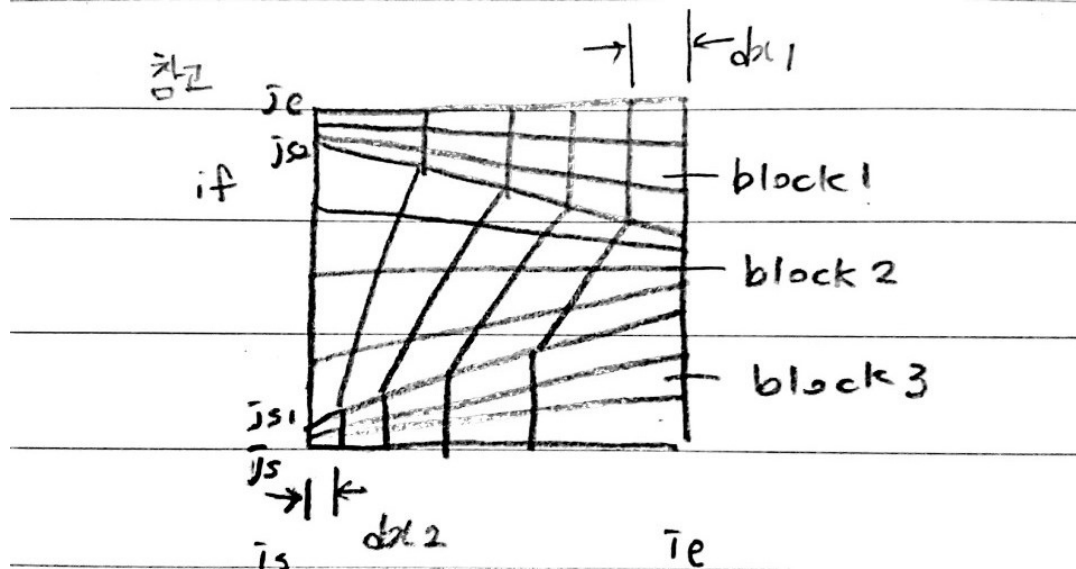
for middle block, you use "JOINT(,GG,   );"

However, this case, for middle block, you use "JOINT(,EE,   );" Why I shoud use 'EE' rather than 'GG'??

First, the command is Join(), not Joint(), and is case sensitive. So, if you use JOIN or join it will not work: it has to be spelled Join. For the third mesh, you can not use Join(is,js,ie,je,j,GG..) because the GG segment grabs the spacing from the mesh along the j coordinate. So in this case, he will set the first grid spacing (between j=js and j=js+1) to the distance between the point (i,js-1) and the point (i,js). However, there is no point (i,js-1) because it is outside of the domain. Good question: 2 points bonus boost.

Question by Student 201227147

Professor, I have a question about the today's class. During the class, to set $js1$ which is the midpoint of js and je, you wrote as follow:

$$js1 = round(0.5 * (je - js));$$

but if I set $js = 40$ and $je = 100$, $js1$ becomes 30 which is not located between js and je. Similarly, you wrote is_1 as follow:

$$is1 = round(((ie - is) - 0.7 * (ie - is))/2);$$

but if I set $is = 40$ *and* $ie = 100,$ $is1$ *becomes 9 which is also not located between* is *and* ie. *Could you tell me what I'm thinking wrong?*

You are not wrong.. Rather, I forgot to include some term. It should have been written:

$$js1 = \text{round}(0.5 * (je - js)) + js;$$

and

$$is1 = \text{round}(0.3 * (ie - is)/2) + is;$$

Good observation: 2 points bonus boost.