Computational Aerodynamics Questions & Answers

Question by Prasanna

Professor, I am a bit confused about question #5 of Assignment 4. I have to find

$$\frac{\partial F_3}{\partial U_4} = \frac{\partial(\rho u^2 + P)}{\partial U_4} = \frac{\partial(\rho u^2)}{\partial U_4} + \frac{\partial P}{\partial U_4}$$

and the difficult part seems to be in determining the $\frac{\partial P}{\partial U_4}$ *term. The alternative method you taught involves using the chain rule, for example,*

$$\frac{\partial F_3}{\partial U_4} = \frac{\partial F_3}{\partial \rho_1}\frac{\partial \rho_1}{\partial U_4} + \frac{\partial F_3}{\partial \rho_2}\frac{\partial \rho_2}{\partial U_4} + \frac{\partial F_3}{\partial u}\frac{\partial u}{\partial U_4} + \frac{\partial F_3}{\partial \phi}\frac{\partial \phi}{\partial U_4}$$

where $F_3 = F_3(\rho_1, \rho_2, u, \phi)$ *and* ϕ *is some variable. For this problem,* ϕ *has to be a function of* U_1, U_2, U_3, U_4 *and also a function of* P *such that I can evaluate* $\frac{\partial \phi}{\partial U_4}$. *But then if I could express* P *in terms of* ϕ *which is a function of* U_1, U_2, U_3, U_4, *I would use the first method which you taught to evaluate the flux jacobian terms instead. I would like your comment regarding this.*

You don't necessarily need to express ϕ as a function of U to determine $\partial\phi/\partial U$ in the same way as you don't need to express F as a function of U to obtain $\partial F/\partial U$.

Question by Van Tien

Professor, in Assignment 5, Question #3, for the extrapolation, I am confused to use the 1D-Lagrange interpolation or 2D-Lagrange interpolation. In the case of 1D-Lagrange interpolation, I am not sure the polynomial function is based on x or y coordinate. In the case of 2D-Lagrange interpolation, I think I need more information from the other nodes.

Use a 1D extrapolation polynomial. 2D is too time consuming to compute.

Question by Student 201983196

Professor, in Assignment7, Question#2, How do I calculate this equation, $\frac{|A|(Z_L,Z_R)}{2}(U(Z_R) - U(Z_L))$? *Is* $\frac{|A|(Z_L,Z_R)}{2}$ *2X1 matrix? But* $(U(Z_R) - U(Z_L))$ *also is 2X1 matrix? I don't know how to calculate* $F_(i + \frac{1}{2}) = \frac{F(Z_L)+F(Z_R)}{2} + \frac{|A|(Z_L,Z_R)}{2}(U(Z_R) - U(Z_L))$

No, $|A|$ is a 2×2 matrix determined from an average state function of Z_L and Z_R.

Question by Prasanna

Professor, for Assignment #7, Question #3, are the answers posted in the following order: u_L *,*u_R *in decimal digits,* u_R *in fraction,* $f(u_L)$ *in decimal digits,* $f(u_L)$ *in fraction respectively?*

I updated the answers to make them more clear.

Question by Student 201983196

Professor, In Assignment#7, Question#2 (b), I use 2nd order polynomial about node(4,5,6) and node(5,6,7). and then using optimal weight, calculate u_R*. but my solution is wrong. I don't know how to solve this Question#2(b).*

Hm, I see a problem in your approach. You shouldn't be finding a polynomial when determining the flux with a TVD minmod2 limiter.

Question by Student 201627128

Professor, in class when you explained how to find WENO3, you found a highest degree polynomial through the data points. Using a similar approach I was able to find u_L *equal to 4.5 as in the solutions, however, when I apply the same strategy to find* u_R*, I get 4.25 instead, which does not match the solution. I tried to do it in reconstruction evolution and again found 4.5 for* u_L *but this time* u_R *becomes 5. Is there a separate approach to find* u_R*?*

I don't understand why using reconstruction-evolution would give you a different answer. You need to find $u_{\rm R}$ by interpolating u. Once u is interpolated and $u_{\rm L}$ and $u_{\rm R}$ are found, then apply reconstruction evolution.