WEEK 10 CHALLENGE

Introduction to OpenFoam Development

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Problem Statement:

Use the backwardFacingStep2D tutorial as described in the lecture and run the case for the following turbulence models:
• SpalartAllmaras
• kEpsilon
• realizableKE
• kOmega
One of these is a one-equation model. Write down the equation and a short note on the turbulence model

Solution:

A brief about the Equations:

1) SpalartAllmaras: Spalart–Allmaras turbulence model - Wikipedia
2) kEpsilon: K-epsilon turbulence model - Wikipedia
3) realizableKE: OpenFOAM: API Guide: realizableKE< BasicTurbulenceModel > Class Template Reference
4) kOmega: k–omega turbulence model - Wikipedia

A short note on the one Equation model (Spalart Allmaras) is attached below.
Also, below is the attached summary + user notes on the simulation:

Summary:

Some key points:

- kEpsilon model is the default model used in this case.
- Sparlart Allmaras model needs an extra term nuTilda to be defined
- kEpsilon and kOmega have similar results which are different from Spalart Allmaras and realizable KE
- kEpsilon and RKE converge in around 300 steps but the other two models go till the end i.e., 2000 iterations

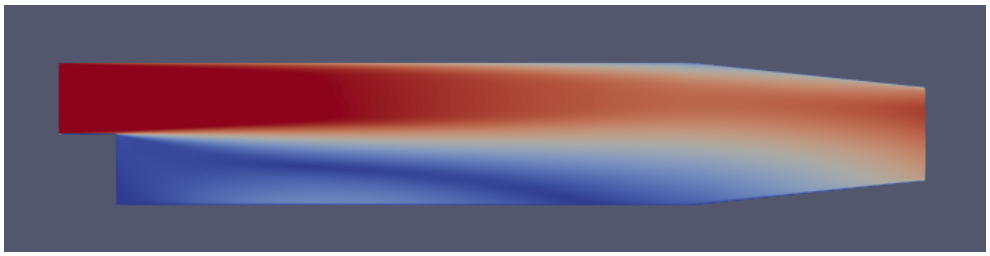
Note: I haven't attached the files here since they were same as pitzDaily except change in a single parameter in the constant/turbulenceProperties

User notes:

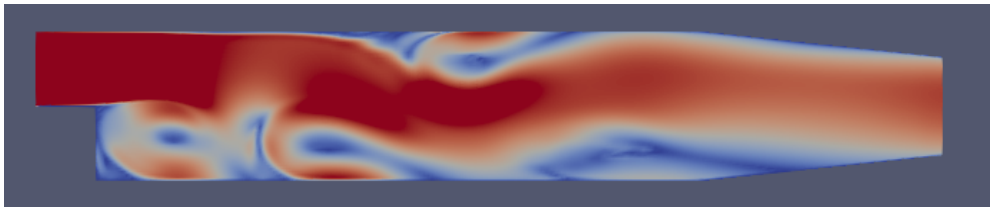
The first issue that I encountered was that the tutorial of backwardFacingStep wasn't present in my openFoam(maybe because of the version). So I downloaded it from the internet and used it. Even after copying the case, it won't run. So I replaced nutUBlendedWallFunction with nutUWallFunction

Then I sticked with pitzDaily case

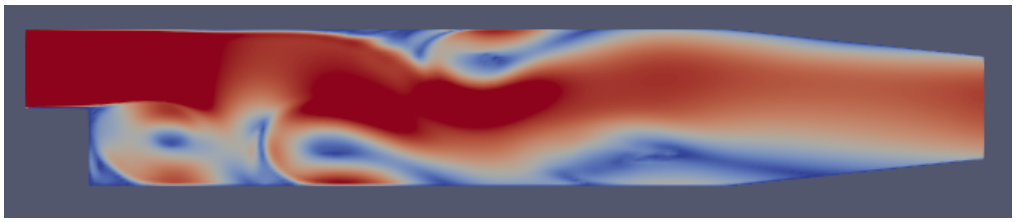
1) *Running with kEpsilon: Two parameter*
    a) *blockMesh followed by simpleFoam results(287 iterations):*



2) *Running with SpalartAllmaras:*
    a) *div(phi,nuTilda) wasn't defined. Same was the case with nuTilda Calc*
    b) *There was an issue with #includeFunc so I commented it out*
    c) *I added both and it converged: Ran for 2000 iterations*



3) *Realizable KE:*
    a) *Removed nuTilda from both places and it converged in 264 iterations:*



4) *kOmega:*
    a) *Took 2000 iterations to converge:*