T-Junction CFD Simulations Using the XYZ Model

Introduction

- General introduction – physics of test case
- Goals of simulation
- History of test case – relevant references
- Discussion of relevant turbulence modelling options

Test Case Description

- Description of experimental set-up (pictures).
- Description of available data.
- Discussion of exp. uncertainties and potential problematic areas (completeness of data, boundary conditions, …)

Turbulence Model Description

- Motivation for model selection (pros – cons)
- Model description (can be a reference if used as published or used in industrial code)
    - The model description in the code documentation should be checked carefully. There are many different variants of (hybrid) models. Details can be very important. Compare to original literature in case of differences.
    - In case of modified models, motivation for changes and details should be given.
- References to related validation studies with the model/code used if available.

Code and Numerics

- Brief description of code – in case of industrial code reference
- Details of numerical settings (maybe using a table in case of several runs)

    - Space discretization (CD, BCD, hybrid, …)
    - Time discretization
        - Time step size
        - CFL number in mixing zone
    - Iterative procedure
        - coupled solver, SIMPLE, Fractional Step, …
    - Convergence criteria (number of iteration per time step, convergence criterion, residual plots)
    - Averaging
        - Number of time steps before averaging
        - Number of time steps during averaging
        - Plots of results after different number of averaged time steps

Test Case Set-Up

- Domain
- Boundary conditions
    - Inlet conditions are especially important for Scale-Resolving Simulations (typically no information on two turbulence scales, etc.)
    - Interfaces (RANS-LES)
    - Synthetic turbulence method
- Grid details
    - Type (hex, hybrid, …)
    - Pictures of grid in different cuts
    - Quality metrics (skew, min angles, …)
    - Near wall resolution (y+, expansion factors)
    - Mesh refinement (if available)

Results

- Pictures of turbulent structures
    - Iso-surface of Q-criterion (Q=S^2-W^2)
    - Other 3D visualizations (for presentations – movies!)
    - Discussion of visual observations
- Comparison of numerical results with data
    - Clearly distinguishable curves plus exp. in one plot (not too many <4?).
    - Readable legend etc.
    - For Scale-Resolving Simulations, numerics is a key element – discuss if possible impact of numerical scheme.

    - Discussion of results also with reference to the model selected and the turbulent structures visualized.
- Problems during simulations
    - Convergence issues
    - Wiggles, …
    - …

Summary and Recommendations

Summary of observations:

- What are the conclusions from the simulations?
- Strength and weaknesses of models selected.

Recommendations:

The models in different codes are rather different. Recommendations might therefore have to be targeted at the specific code used in the study.