COMPUTATIONAL FLUID DYNAMICS

Project report grading

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MY PART

- Who am I
  - Master of Science in Energy Engineering
  - Industrial PhD at the department of physics
    - Applied material science

- Attended course in 2015
  - Good understanding, not working with the subject
  - I will focus on the quality of the report

- I will correct and grade your project reports

- Why me and not Krister
  - Anonymous
  - Most importantly, Krister can help you more and in a better way during the lab sessions

GENERAL INFO

- Point system
  - Based on criteria
  - Video on Canvas

- Reduce points
  - Feed back, room for improvements
  - I should motivate reduction

- Bonus system
  - Reward: good results, ambition, well written report, etc.
  - Injector simulation
  - One grad available (20 %)

GENERAL INFO

- Changes to the project
  - 3D injector
  - More focus on creativity and good simulation
  - Imitate real life project
  - Less ambiguity (criteria)

- Result and discussion
  - Majority of points
  - Separate section

- Preparation for Master thesis

GRADING CRITERIA

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EXAMPLES

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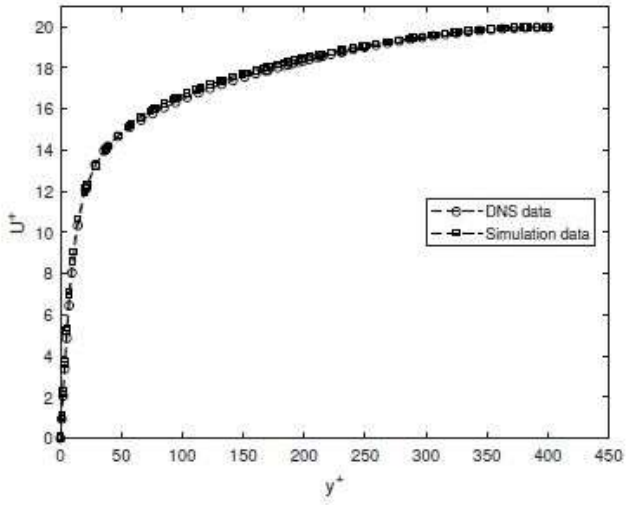
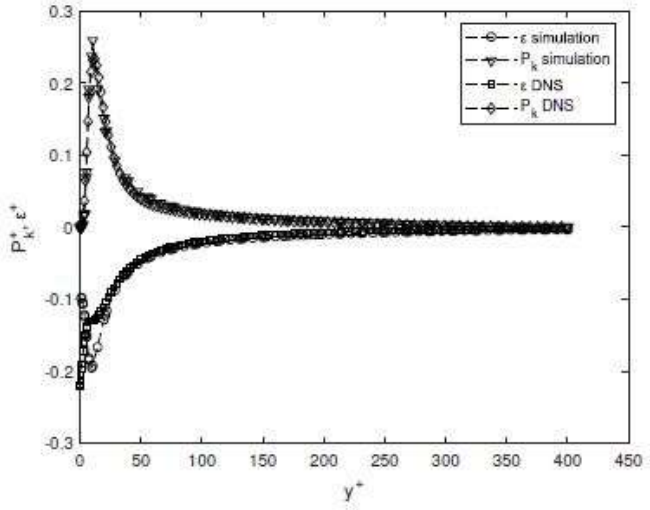
RESULT SECTION

For the verification of the turbulence model, data from an unpublish work of Kim et al.[4] for a channel with $Re_\tau = 395$ was used as reference. The dimensionless velocity profile was compared, the plot is shown in figure 5a. The velocity profile from the simulation generally corresponds well to the DNS data, with the exception of the section between $y^+ = 50$ and $y^+ = 200$, where the simulation over predicts the velocity.

The production and dissipation of turbulent kinetic energy, P_k and ε, was also compared. The plot is shown in figure 5b. The production in the simulation follows the trend of the production from the DNS data, with the exception of the over prediction in the turbulent log layer and the outer turbulent layer, and that the peak in the simulation is closer to $y^+ = 10$, while the peak in the DNS data is at $y^+ = 11$. The dissipation in the simulation also follows the trend from the DNS data well in the log layer and the outer layer but with an over prediction similar to the behaviour of the production. For $y^+ < 30$, the DNS data reaches a plateau around $y^+ = 11$, to then increase and reach its peak at the wall. In the simulation, ε instead reaches its peak around $y^+ = 10$ and then decreases closer to the wall.





RESULT SECTION

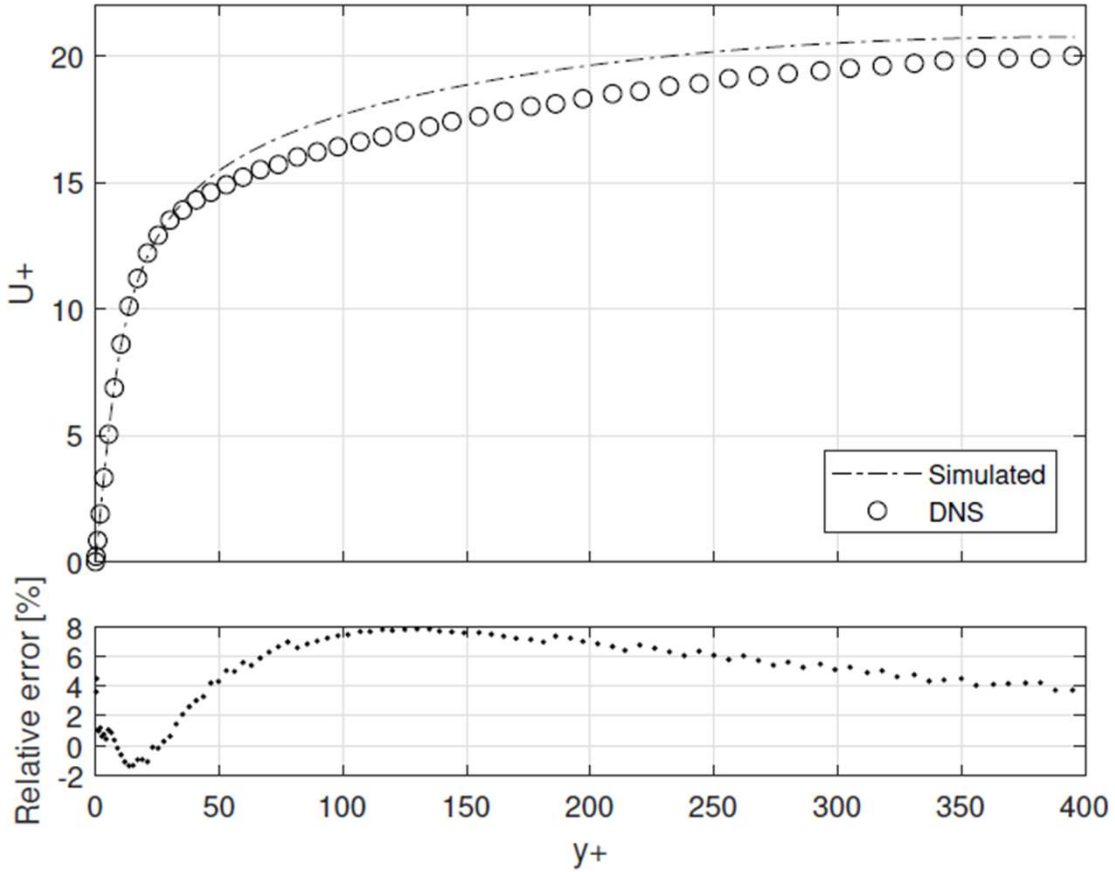


Figure 4 – Dimensionless velocity profile of channel flow. Simulated data on $Re_\tau = 396$ is presented and compared to DNS data for $Re_\tau = 395$ by Kim et al. [1]. Relative error is defined such that positive value means simulated value is too high.

REFERENCE LIST

References

[1] COMSOL (2018), *CFD Module User's Guide*, COMSOL 5.4, Part No. CM021301

[2] H K Versteeg and W Malalasekera (2007), *An Introduction to Computional Fluid Dynamics*, 2nd edition, Pearson.

[3] De Brederode, V. and Bradshaw, P. 1974 *Three-dimensional flow in nominally two-dimensional separation bubbles. I. Flow behind a rearward-facing step.* Tech. Rep., IC Aero Rep 72-19, Imperial College, London

[4] Kim et al. (1987), *Channel flow*, http://cfd.mace.manchester.ac.uk/ercoftac/classif.html, (Retrieved 2020-01-17)

[5] Wang, F.-F., Wu, S.-Q., Zhu, S.-L. *Numerical simulation of flow separation over a backward-facing step with high Reynolds number*, Water Science and Engineering, 12(2)(2019), pp. 145-154

[6] Jones W. P., Launder B. E., *The prediction of laminarization with a two-equation model of turbulence*, Int. J Heat Mass Transfer, Vol. 15(1972), pp. 301-314

COMMON MISTAKES

- Abstract
  - Context, problem/motivation, project, result/conclusion
- Theory
  - Context and motivate steps in text
- Mesh description
  - Should be reproduceable
- In discussion, reconnect to aim/goal
  - Did you fulfill your goals, what was the outcome
- Conclusion
  - Not a continuation of the discussion

ADDITIONAL INFO

- Project discussion next week
- Can always contact me
  - erik.zall@umu.se
  - Contact me if anything feels unclear regarding the grading!
- Uploaded resources
  - This presentation, criteria video, grading criteria, common mistakes, writing guidelines

QUESTIONS?

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