Chair of Aerodynamics and Fluid Mechanics
TUM School of Engineering and Design
Technical University of Munich

Differentiable RANS Solver

Semesterarbeit

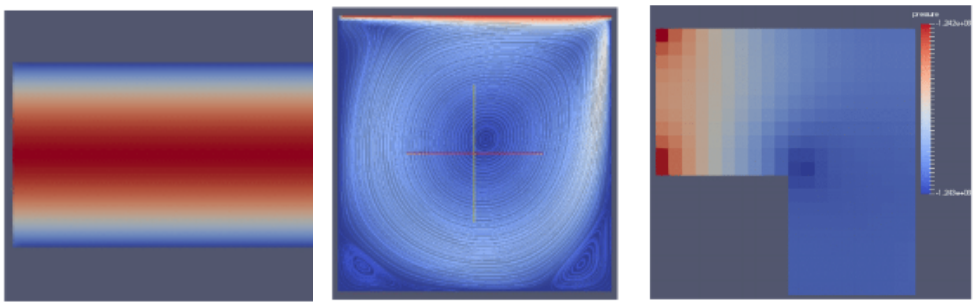

Fig. 1: From left to right: channel flow, lid-driven cavity, backward-facing step (lecture 6)

Project description

Implement a differentiable solver on the 3 problem above 1. First as normal incompressible NSE solver, 2. Then using 0- and 1-equation models. For the implementation we will use PyTorch, and if time permits also JAX. Lecture materials, PhiFlow, etc.

What this project is **not** about: compressible stuff, domain decomposition, CPU vs GPU, 3D, Paraview

Steps

5. Write an incompressible NSE solver for the channel flow problem using PyTorch (3, 5, 6)
    a. Include validation and verification, i.e. comprare velocity profile with reference solutions
6. Extend code to RANS with 0-equation model and 1-equation model (L 11)
7. Extend code to lid-driven cavity and backward-facing step
8. If time permits:
    a. Implement the k-Omega and k-Epsilon models, and use then at different parts of the domain
    b. implement everything also in JAX
    c. Think of improving performance with Finite Volumes and higher-order time integration (RK4)

Requirements

- PyTorch.
- Interest in fluid mechanics
- Teamwork skills.

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