Application of the new turbo-machinery module to a mixed compressor and in-situ visualisation.

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1. Rotating pipe (S. Rolfo)

2. Code_Saturne in-situ visualization (B. Lorendeau)

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1 Rotating pipe (S. Rolfo)

2 *Code_Saturne* in-situ visualization (B. Lorendeau)
Rotating pipe: Test case description

**Flow parameter**

- Laminar flow $Re = 500$ (based on diameter and inlet bulk velocity)
  - Fully developed laminar inlet (parabolic profile)
- Middle section rotating at rotation rate $\alpha = \frac{V_\theta}{U_B} = 2.5$

**Calculations definition**

- Single domain with imposed wall velocity
- Code-Code coupling with 3 instances and sliding plane
  - Mesh rotation
  - Coriolis source force
- Turbo-machinery module with mesh joining
  - Mesh rotation and gluing at every time step
  - Coriolis source force with mesh joining at the start of the simulation
- Mesh with 256 cells in the cross section for 56 planes in the steamwise direction, for total length of $5D$
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Rotating pipe: Test case view
Comparison: Profiles along flow direction

Rolfo et al.  Code_Saturne User Meeting
Comparison:
Profiles along flow direction

- C-C coupling with mesh rotation less sensitive to the rotation
- Turbo module with mesh rotation enhance the effect of the outlet interface
- Turbo module with frozen rotor is the closest to the imposed wall velocity
- Both methods with mesh rotation show fluctuations up-stream and in the rotor

Line x=0

![Graph showing comparison of pressure profiles along the flow direction.](image)
Comparison:
Profiles along flow direction

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2. *Code_Saturne* in-situ visualization (B. Lorendeau)
Integration of Catalyst into Code_Saturne

- Tightly coupled solution
- Designed for tackling bad I/O performances
- Allows users to visualize their data at simulation-time
How to use it

Play the video
Advantages & Downsides

**Advantages**
- Faster simulation
- Video generation
- Reduction of data volume
- Visualize during simulation

**Downsides**
- Not for exploration
- Limited Interactivity
- Memory usage
Performances on 200M

Execution time of the simulation with and without coprocessing: 204M mesh & 9 slices
Performances on 50M

Execution time of the simulation with and without coprocessing: 51M mesh & volume rendering
Comparison Charts

- Size: 204M & 9 Slices

- Size: 51M & Volume Rendering
Future Work

Integration of Catalyst into CodeSaturne

- Makes simulation and visualization works together
- Runs a pre-defined VTK pipeline on the simulation data

- Scaling and processing time very satisfactory
- Memory management being optimized
- Further tests on BlueGene Q with 500 millions of hexaedrons
- Further tests on the Live Visualization